CIMARRON CORPORATION
P. O. BOX 25861 • OKLAHOMA CITY, OKLAHOMA 73125

April 7, 1995

S. JESS LARSEN
VICE PRESIDENT

Mr. Michael F. Weber, Chief
Low-Level Waste Management
and Decommissioning Projects Branch
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Docket No. 70-0925
License No. SNM-928
Cimarron Facility Soil Survey

Dear Mr. Weber:

In accordance with License No. SNM-928, Amendment No. 10, dated November 4, 1994 which authorizes on-site burial of soil contaminated with low-enriched uranium as defined in the Branch Technical Position (Federal Register 52061) Option 2 concentration range, Cimarron Corporation herein submits four copies of a report detailing the radiological characterization of a third contaminated soil pile. Cimarron believes the third pile is acceptable for disposal, as demonstrated in the report.

Placement in the on-site burial cell of the two soil piles previously authorized by NRC staff for disposal is approximately 75% complete, and the job has progressed very smoothly. In order to maintain the level of progress currently enjoyed, Cimarron respectfully urges NRC staff's early review of this report. The staff's timely authorization for disposal of this third pile could ensure the flow of work will continue without a pause.

Cimarron believes the report supplies sufficient information to demonstrate characterization of this pile is consistent with the two piles previously approved by NRC for disposal. Please call Joe Kegin at 405/282-6722 or me at 405/270-2288 if you have any questions concerning this matter.

Sincerely,

Jess Larsen

Jess Larsen
Vice-President, Cimarron Corporation

Enclosures: 4 copies

copies: G. Rice
J. Stauter
J. Kegin
Cimarron License file

KERR-McGEE CORPORATION

Report on the

Radiological Survey Results

of

Option 2 Stockpile No. 3

License No. SNM-928
Docket No. 70-0925

CIMARRON CORPORATION
OKLAHOMA CITY, OKLAHOMA

RADIOLOGICAL CHARACTERIZATION RESULTS

FOR OPTION #2 SOIL STOCKPILE NO. 3

LICENSE NO: SNM-928
DOCKET NO: 70-0925

CIMARRON FACILITY

CIMARRON CORPORATION

OKLAHOMA CITY, OKLAHOMA

APRIL, 1995

1.0 Introduction

On November 4, 1994, the Nuclear Regulatory Commission (NRC) issued an amendment to Cimarron Corporation's License SNM-928 (Amendment #10). Condition #23 of that amendment allows on-site disposal of up to 14,000 cubic meters (500,000 cubic feet) of soil having a uranium concentration consistent with limits specified in the NRC Branch Technical Position on Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations, Federal Register/Vol. 46, No. 205/page 52601, (BTP) Option 2. Table 1-1 shows the BTP Option limits for enriched uranium. The concentration of thorium and plutonium in the soil must not exceed 10 pCi/g and 1 pCi/g, respectively. All contaminated soil and debris shall be buried at a minimum depth of four feet below ground surface and shall be compacted in one foot lifts.

Cimarron Corporation has been stockpiling soil and debris contaminated with enriched uranium at BTP Option #2 concentrations on-site. This contaminated material is placed in a stockpile as it is removed from an area being decommissioned. This allows for final characterization of the contaminated materials in the stockpile prior to placement of these materials in the on-site disposal cell. Two stockpiles (herein referred to as DAP-1 and DAP-2) of Option #2 material located northeast and east of the Uranium Plant Building were characterized in 1994 by Cimarron personnel. ORISE performed a confirmatory survey and sampling effort on the two piles and submitted a report of their findings to the NRC. DAP-1 and DAP-2 were subsequently approved for on-site disposal by the NRC by letter dated February 16, 1995 and are currently in the process of being disposed in the on-site disposal cell.

Accumulation of Stockpile DAP-3 was started in 1994. This stockpile is located in the uranium plant yard next to the DAP-1 & 2 areas and is shown on Figure 1. Prior to placement of the contaminated material from DAP-3 in the on-site disposal cell, Cimarron Corporation has performed a characterization of the materials in accordance with the guidance contained in Draft NUREG/CR-5849. The procedures used for this characterization are identical to those reviewed and approved by the NRC for stockpiles DAP-1 and 2.

The purpose of this report is to present the DAP-3 characterization data to the NRC for review prior to giving approval for on-site disposal. This report also describes the methodologies and procedures utilized by Cimarron Corporation while performing the characterization of DAP-3.

2.0 Characterization of DAP-3

A volume of approximately 42,000 cubic feet (1,560 cubic meters) of contaminated soil and debris has been placed in DAP-3. The contaminated soil and debris contained in DAP-3 is

the result of on-going site decommissioning activities. Contaminated materials placed in DAP-3 were removed from the burial area #2 (north field drainage area), the uranium building south yard area, and the uranium building yard area east of the electrical supply sub-station. These locations are shown on Figure 1.

2.1 Data Generation

The surface of DAP-3 was leveled in order to facilitate surveying and sampling of the stockpile. DAP-3 was subdivided on a 5 meter by 5 meter grid which was tied directly to an established survey reference point for the site. The survey reference point is shown on Figure 1. DAP-3 was then surveyed using a micro-R survey meter at the surface and at a height of one meter. The surface was also surveyed using a shielded 3" x 0.5" NaI detector. Boreholes were drilled through the stockpile to obtain soil samples at various depths. Soil samples were collected and composited over each half meter interval through the entire depth of the stockpile. The soil samples were then counted utilizing the on-site soil counter (gamma spectrum analysis). In addition, a dirt probe consisting of a 1.5" x 4" NaI detector was utilized to obtain a count rate at each 0.5 meter depth interval for each borehole.

2.2 Data Evaluation

The individual survey and soil sample data and the statistical data analyses and summaries resulting from the characterization effort are contained in Appendix 1. This information is also displayed on drawings in Appendix 2. A total of 143 soil samples were analyzed for both total uranium and total thorium. Total uranium concentrations ranged from 13 pCi/g to 164 pCi/g for the 143 samples, with an average total uranium concentration of 41 ± 23 pCi/g (1 sigma error). Total thorium concentrations ranged from 1 to 3 pCi/g, and averaged 2 pCi/g for the 143 samples. This information is presented in Appendix 3. Samples sent to off-site laboratories as part of the Cimarron quality assurance program were also analyzed for Plutonium-239. Plutonium-239 concentrations reported by Core laboratory ranged from 0.1 ± 0.3 pCi/g to 0.7 ± 0.6 pCi/g for the three samples analyzed, while the concentrations reported by Teledyne-Brown Laboratory ranged from less than 0.02 pCi/g to 0.025 ± 0.019 pCi/g.

Uranium concentrations in samples were averaged utilizing the methodology provided in Draft NUREG/CR-5849 (Equation 8-13) to determine if the average uranium concentration for the stockpile was equal to or less than the guideline value, at the 95 percent confidence level. The comparison testing was calculated utilizing the formula listed below:

$$\mu_\alpha = \text{Mean} + t_{1-\alpha,df}\,(S_x/\sqrt{n})$$

Where:

Number of samples, n	= 143
Sum of sample concentrations	= 5788
Mean	= 40.5 pCi/g U (Equation 8-11)
Standard Deviation, S_x	= 22.5 pCi/g U (Equation 8-12)
95% C.L. for mean, $t_{1-\alpha,df}$	= 1.657 for 142 degrees of freedom
Guideline value (Criterion)	= 100 pCi/g total uranium average

$$\mu_\alpha = 40.5 + 1.657(22.5/\sqrt{143}) = 43.6 \text{ pCi/g uranium}$$

∴ **CRITERION SATISFIED**.

The calculated value of μ_α is less than the criterion value of 100 pCi/g total uranium.

As discussed in Section 1.0 of this report, the guideline value for contaminated soil and debris to be disposed of on-site is 100 pCi/g total uranium average (this corresponds to the BTP Option #2 concentration limit for 100% soluble enriched uranium contamination). Three soil sample locations in DAP-3 had total uranium concentrations which exceeded the guideline value of 100 pCi/g. These sample locations, along with the surrounding sample locations, were averaged utilizing the "hot-spot" averaging criteria provided in Draft NUREG/CR-5849 (Equation 8-10) to determine if the average total uranium concentration in the 100 m^2 contiguous area was equal to or less than the guideline value. The weighted average was calculated utilizing the formula listed below:

$$X_w = (NEA)[(1-A)/100] + (EA)(A/100)$$

where:

NEA = "Non-elevated average", average of samples less than 100 pCi/g uranium;
EA = "Elevated average", average of samples exceeding 100 pCi/g uranium;
A = Area taken up by all samples exceeding the criteria.
X_w = Weighted average in pCi/g

The average value calculated through the use of the above formula for each of these "hot-spots" was below the guideline value of 100 pCi/g total uranium. The calculation results are presented in Tables 2-1 through 2-4.

3.0 Cimarron Radiation Protection Program

The Cimarron Radiation Protection Program ensures that all employees, visitors and the general public are protected from radiological hazards which may be present due to licensed activities conducted at the facility. Cimarron Corporation maintains a Radiation Protection Program which meets or exceeds all applicable regulatory requirements associated with all activities conducted under Special Nuclear Materials License SNM-928 and By-Product License 35-12636-02.

The Cimarron Radiation Protection Program currently in place for all decommissioning activities is administered through the use of the following documents:

- Cimarron Radiation Protection Procedures
- Cimarron Site Health and Safety Plan
- Cimarron Quality Assurance Plan and Procedures
- Cimarron Emergency Plan

Corporate audits for regulatory and internal requirements are conducted on a periodic basis and include the review of the Cimarron Radiation Protection Program and the associated elements. Assessments of program effectiveness are also performed periodically by the Cimarron Radiation Safety Officer/Health Physics Supervisor. Additionally, the program is inspected for compliance with applicable rules and regulations by the Oklahoma Department of Health, NRC Region IV, and NRC Headquarters staff.

3.1 Cimarron Quality Assurance Program

The Cimarron Corporation Quality Assurance Plan and Procedures are an integral part of the Cimarron Radiation Protection Program. A principal component of this program is to affirm the quality of project work performed during decommissioning by assuring that all tasks are performed in an organized manner by qualified personnel. The Program ensures that all samples are collected, controlled and analyzed in accordance with all applicable quality controls such that data accuracy and validity are verifiable. The data generated is compared to the criteria discussed in Sections 1.0 and 2.2 and managed per approved Cimarron procedures. Such quality controls allow for the independent verification of analysis results by third party review, thereby assuring that all characterization data is accurate and complete.

The Cimarron Quality Assurance Program is implemented and maintained in accordance with written policies, procedures, and instructions. This Quality Assurance Program is administered under the direction of the Quality Assurance Manager. Periodic audits and reviews are conducted to ensure that all aspects of the Cimarron Quality Assurance Program are addressed. The Cimarron Quality

Assurance Program satisfies the applicable requirements of 10 CFR 50, Appendix B and NQA-1.

3.1.1 Sample Chain of Custody

Field data are gathered and maintained in field logs for all samples in accordance with the Cimarron QA program. Necessary data are transferred to the laboratory sample log when the sample is brought to the on-site laboratory for analysis. The sample logs provide a record of sample collection and transport and are placed into the facility quality assurance files at appropriate intervals.

Samples shipped to off-site independent laboratories for analysis are accompanied by a chain of custody form in accordance with the Cimarron Quality Assurance Program. These forms provide documentation of sample handling and are maintained by the Quality Assurance Manager as permanent records.

3.1.2 Verification Samples

Off-site analysis of split samples is an integral part of the quality assurance program. Results for these samples is presented in Section 5.0.

4.0 Instrumentation

The instrumentation utilized to generate the characterization data discussed above are calibrated and maintained at the Cimarron site in accordance with the associated Radiation Protection Program procedures. These procedures utilize the guidance contained in ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration". Specific requirements for instrumentation include traceability of calibrations to NIST standards, field checks of operability, background radioactivity checks, operation of instruments within established environmental bounds (i.e, temperature and pressure), training of individuals, scheduled performance checks, calibration to isotopes with energies similar to those to be measured, quality assurance tests, review of data, and recordkeeping. The specific instrumentation utilized during this characterization effort for DAP-3 is listed in the following sections.

4.1 Survey Instrumentation

Portable survey instruments (micro-R survey meters, α/β survey meters, dose rate instruments, scalers/ratemeters, etc.) are calibrated on a quarterly basis. All instrumentation is calibrated with NIST traceable standards. Where applicable, activities of sources utilized for calibration are corrected for decay. In addition to the quarterly calibration requirements, source checks are required for all instruments being utilized for characterization work on a daily basis. A calibrated electronic pulse generator is utilized for instrument scale linearity checks.

All calibration and source check records are completed, reviewed and retained in accordance with Cimarron Quality Assurance Plan and Procedure requirements.

Survey results generated through the use of site instrumentation have continued to show general agreement with survey measurements recorded during independent confirmatory surveys performed at the Cimarron site. Such independent surveys have been conducted by the NRC, ORISE and the State of Oklahoma.

4.2 Shielded 3" x 0.5" NaI Gamma Detector

The 3" x 0.5" detector is a sodium iodide (NaI) crystal gamma detector which is shielded around the sides and socket end in order to ensure that the detector is as directional as possible. The NaI detector is utilized with a portable scaler/ratemeter that has single channel analyzer capability. Americium-241, Uranium-235, and Natural Thorium sources are utilized to set the instrumentation window and threshold to detect gamma energies in the range of 50 to 250 keV. This energy range corresponds to the energies of interest when surveying for uranium and natural thorium contamination. The instrument is normally operated in the window "out" mode, meaning that the instrument response is for the entire range of detectable energies. This mode of operation ensures the detection of elevated areas corresponding to gamma emitters outside the energy range of 50-250 keV. The window "in" mode is utilized to perform additional characterization of elevated areas that are detected using the window "out" mode.

Ranges are established for differentiating between Option #1, Option #2, and Option #4 materials by correlating counts per unit time to known uranium and/or thorium concentrations in the soil or debris. This allows the 3" x 0.5" NaI detector to be used for qualitative "in-situ" surface identification and differentiation of contaminated soil and debris. Quantitative analysis of contaminated materials is performed with the on-site counter.

4.3 Unshielded 1.25" x 4" NaI Gamma Detector (Dirt Probe)

The 1.25" x 4" detector is a sodium iodide (NaI) crystal gamma detector encased in a length of 2" PVC pipe with a brass tip that can be inserted into a bucket or pile of dirt. This detector is referred to as the "dirt probe" by Cimarron personnel. The NaI detector is utilized with a portable scaler/ratemeter that has single channel analyzer capability. Americium-241, Uranium-235, and Natural Thorium sources are utilized to set the instrumentation window and threshold to detect gamma energies in the range of 50 to 250 keV. This energy range corresponds to the energies of interest when surveying for uranium and natural thorium contamination.

The instrumentation described above is then calibrated by inserting the probe into a tube positioned in several drums of soil with defined uranium concentrations. A range is then established for differentiating between Option #1, Option #2, and Option #4 materials by correlating counts per unit time for each drum to known uranium concentrations in each drum. This allows for qualitative "in-situ" identification and differentiation of sub-surface contaminated soil and debris. Quantitative analysis of contaminated materials is performed with the on-site soil counter.

4.4 Soil Counter (Gamma Spectroscopy)

The Cimarron Soil Counter consists of a 4" x 4" x 16" sodium iodide crystal housed in a shielded chamber which is computer linked to a multi-channel analyzer (MCA). Data from the MCA is processed through an EG&G Ortec Analysis Program which, in turn, determines uranium and thorium concentrations in soil samples.

Calibration of this counting system is traceable to NIST standards through contractor laboratory evaluations of the on-site standards. The standard concentrations have been confirmed through measurements performed by the Oak Ridge Institute for Science and Education (ORISE). ORISE has been used by the NRC for verification of a majority of the decommissioning work completed to date at the Cimarron site. ORISE has conducted an evaluation of the Cimarron Soil Counting system's ability to accurately measure total uranium concentrations in soil samples. This was done by comparing ORISE sample analysis results obtained by alpha pulse height analysis and gamma spectroscopy with the results obtained from the use of the Cimarron Soil Counter. ORISE and Cimarron analysis results compared favorably at levels above background. Background level concentrations were noted to be biased high for the soil counter when analyzing soil samples with uranium concentrations at or below background concentrations (see August 31, 1989 letter from Mr. J. Berger (ORISE) to Mr. R. Hurt (NRC)).

Established quality assurance measures for the soil counter include cesium-137 centroid checks, Chi-square tests, background determination, and the counting of

appropriate standards each time the soil counter is used. All of these quality assurance measures are plotted on control charts and are trended on a continuing basis.

Standards used for calibration and quality assurance checks on the soil counter have been analyzed by outside laboratories and are NIST traceable through these analyses. Comparison results between the standards as counted using the soil counter and two off-site laboratories are presented in Table 6-2. The assigned values for the standards are the average of the results obtained for the off-site labs, when the standards were analyzed by more than one lab. As shown in Table 6-2, the standards range in concentration from 4.5 pCi/g to 292 pCi/g, thus covering the entire range of interest for the Cimarron characterization and remediation activities.
The soil counter determines uranium and thorium activities based upon the evaluation of net counts. Activities are calculated through the use of efficiency and correction factors obtained using appropriate standards. Soil concentrations are calculated by dividing the net activity by the soil mass or weight. Soil weights are determined on a laboratory scale which is checked on a daily basis, when in use, utilizing NIST traceable standards. Total uranium concentrations are calculated from the uranium data by applying the site average enrichment value of 2.7 weight percent for Uranium-235.

5.0 Independent Laboratory Analysis Data Comparison

Three random samples were taken from DAP-3 and split with two off-site independent laboratories for comparison with the Cimarron Soil Counter analysis results. Analysis for total uranium by gamma spectroscopy, isotopic uranium by alpha spectrometry, and total thorium by gamma spectroscopy is shown in Table 5-1. In addition, twelve soil samples from other areas on the Cimarron site were submitted for off-site analysis to Core Lab during this time period to satisfy the quarterly QA/QC requirements for the soil counter. This data is also included in Table 5-1. Total uranium results as measured by Core Lab were plotted and compared to sample results from the Cimarron soil counter for 15 samples ranging in concentration from 1.7 to 66.5 pCi/g (as reported by Core Lab). The samples used for this comparison were collected during characterization on the three disposal stockpiles (DAP-1, DAP-2, and DAP-3), as well as the South Uranium Yard area. As shown by Figure 2, the results are in good agreement. Comparison of analytical results show general agreement between the laboratories.

The second independent laboratory had analytical results for the three split samples for DAP-3 which were not in general agreement with the other sample analysis results for the same split samples. It should be noted that the chemical recovery for these samples were poor and that the volume of sample prepared for analysis was small. Cimarron health physics staff

believes that this discrepancy is due to independent laboratory sample preparation and chemical recovery problems.

Calibration standards used to check performance of the Cimarron Soil Counter have been analyzed by independent laboratories. The comparrison results are shown in Table 5-2.

6.0 Cimarron Site Background

Natural background concentrations for uranium and thorium in soil have not been subtracted from the reported sample analysis results at Cimarron. Background has not been subtracted in order to ensure that a conservative estimate of uranium and thorium concentrations in soil is utilized during decommissioning activities.

Natural background for uranium and thorium in soil have been established through numerous measurements by Cimarron personnel utilizing the on-site soil counter and by independent laboratories. Results for Cimarron's annual environmental samples have been reported to the NRC since 1983 in Cimarron's Annual Environmental Sample Result Reports. These sample results are representative of background levels in the surrounding soils. Eleven background locations on the Cimarron site and in surrounding areas were sampled and reported to the NRC in 1994.

Cimarron's environmental monitoring program currently requires the collection of composite samples from the surface and at depth (0 to 10 inches) from each of the eleven sampling locations.

Sixteen samples from eight locations, 0.5 and 1.0 miles from the site, were utilized for determining background. The analytical results for total uranium varied from 3.03 pCi/g to 10.96 pCi/g and for thorium from 0.83 pCi/g to 2.45 pCi/g as analyzed using the Cimarron soil counter. The average background concentration for the 16 environmental soil samples was determined to be approximately 6 pCi/g total uranium and 1.5 pCi/g thorium. The levels of interest for the characterization of DAP-3 are in the range of 30 to 300 pCi/g uranium. In addition, site background has not been subtracted from the sample results for DAP-3, thus resulting in the use of conservative values for purposes of determining the acceptability of materials for disposal.

Background exposure rates have been established at the Cimarron site by taking micro-R readings at off-site sample locations, in addition to Cimarron site areas which are unaffected by past operations. Site background rates of approximately 7 μR/h have been observed in background areas by Cimarron personnel utilizing a Ludlum Micro-R survey meter. Site background exposure rates of approximately 7 μR/h have also been determined by ORISE personnel utilizing similar instrumentation. In addition, site background exposure rates have

been determined by ORISE personnel utilizing a pressurized ion chamber (PIC). Based on the PIC measurements, the site background was determined to be approximately 10 μR/hr.

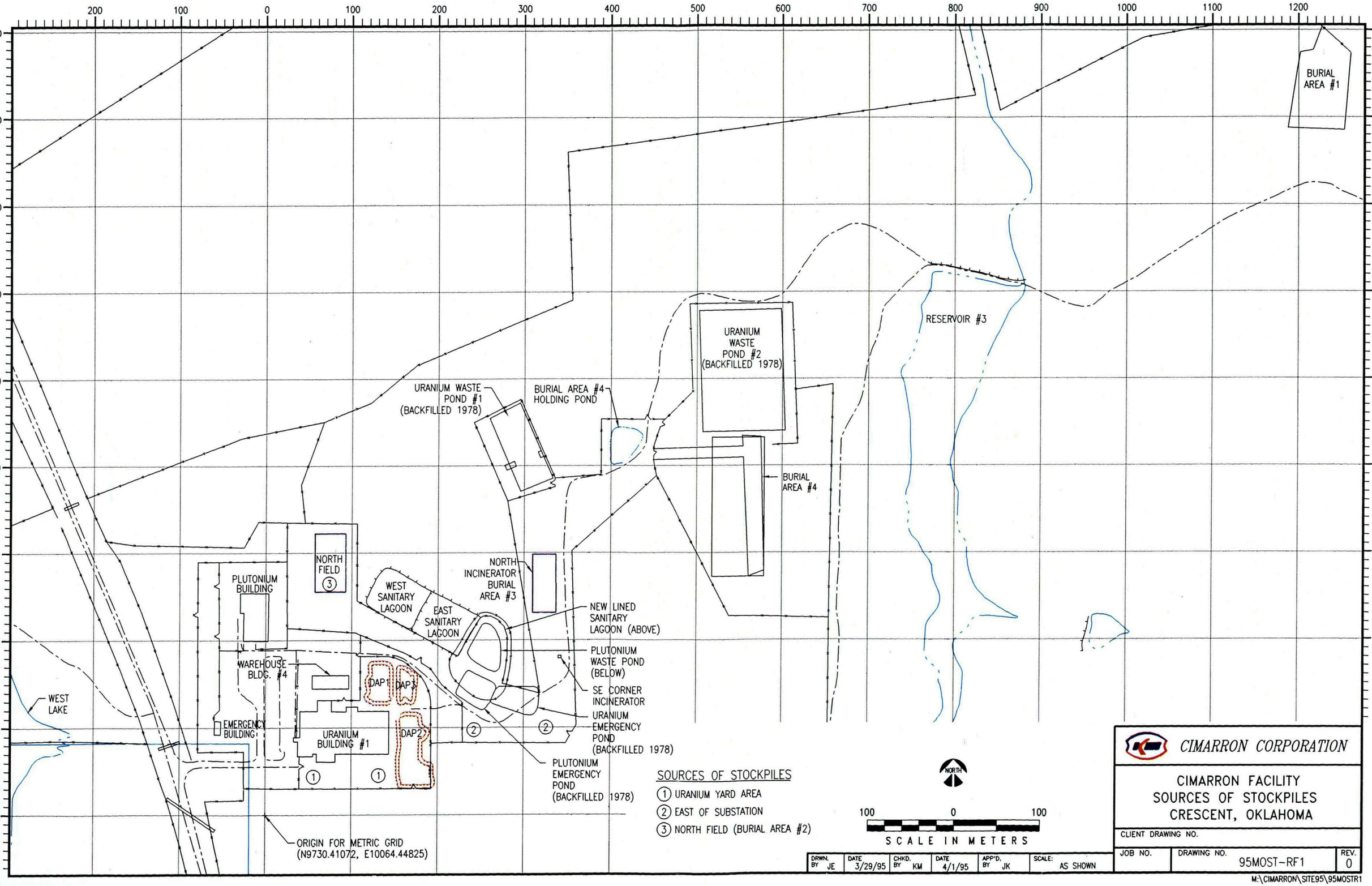
7.0 Training

Cimarron Corporation provides continuing training for all Cimarron personnel and any other personnel (i.e, contractors, visitors, etc.) who are allowed access to the Cimarron site. All personnel associated with the characterization of DAP-3 were trained on the project work plan and the associated special work permits, which included all survey procedures and quality assurance requirements associated with the DAP-3 characterizations.

8.0 Conclusion

Cimarron Corporation has completed the characterization of stockpile DAP-3. The characterization of stockpile DAP-3 is identical to that which was performed on DAP-1 & DAP-2 which were approved for on-site disposal by the NRC after confirmation by ORISE. This characterization has shown that all materials contained in stockpile DAP-3 are below the guideline value for on-site disposal (100 pCi/g) as established in amendment #10 to license SNM-928.

Cimarron Corporation believes that a confirmatory survey by ORISE on DAP-3 is unnecessary based upon the use of the Cimarron Quality Assurance Program and independent off-site laboratories during the characterization of DAP-3. Therefore, Cimarron Corporation requests an expedited review and approval from the NRC to dispose of the soil and debris contained in stockpile DAP-3 in the on-site disposal cell.


BURIAL AREA #1
RESERVOIR #3
URANIUM WASTE POND #2 (BACKFILLED 1978)
URANIUM WASTE POND #1 (BACKFILLED 1978)
BURIAL AREA #4 HOLDING POND
BURIAL AREA #4
NORTH FIELD
3
PLUTONIUM BUILDING
WEST SANITARY LAGOON
EAST SANITARY LAGOON
NORTH INCINERATOR BURIAL AREA #3
NEW LINED SANITARY LAGOON (ABOVE)
PLUTONIUM WASTE POND (BELOW)
SE CORNER INCINERATOR
URANIUM EMERGENCY POND (BACKFILLED 1978)
PLUTONIUM EMERGENCY POND (BACKFILLED 1978)
WAREHOUSE BLDG. #4
DAP1
DAP3
DAP2
EMERGENCY BUILDING
URANIUM BUILDING #1
1
2
WEST LAKE
ORIGIN FOR METRIC GRID (N9730.41072, E10064.44825)
SOURCES OF STOCKPILES
1 URANIUM YARD AREA
2 EAST OF SUBSTATION
3 NORTH FIELD (BURIAL AREA #2)
NORTH
100 0 100
SCALE IN METERS
CIMARRON CORPORATION
CIMARRON FACILITY
SOURCES OF STOCKPILES
CRESCENT, OKLAHOMA
CLIENT DRAWING NO.
JOB NO.
DRAWING NO. 95MOST-RF1
REV. 0
DRWN. BY JE
DATE 3/29/95
CHKD. BY KM
DATE 4/1/95
APP'D. BY JK
SCALE: AS SHOWN
M:\CIMARRON\SITE95\95MOSTR1

CIMARRON CORPORATION, CIMARRON FACILITY
DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 130N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR		0 - .5M			.5M - 1M			1M - 1.5M			1.5M - 2.0M		
			I-M	SUR	U	Th	Dirt Probe	U	Th	Dirt Probe	U	Th	Dirt Probe	U	TH	Dirt Probe
130N - 157E		4136	9	8	26	2	24954	26	2	28274	34	2	29612	34	2	29580
130N - 160E		4538	11	10	42	3	25792	30	2	29450	34	2	27734	28	2	27368
130N - 165E		5080	11	12	25	2	28592	28	2	28536	30	2	CAVE-IN	---	---	---
130N - 170E		4292	10	11	27	2	25264	22	2	27634	29	2	27942	32	2	28266

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.A. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 135N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
135N - 157E		4592	9	9	24	3	26742	35	2	26664	29	2	26910	30	2	27928
135N - 160E		4772	12	10	35	2	28940	32	2	28176	35	2	27340	31	2	27558
135N - 165E		4598	9	9	29	2	24534	24	2	26878	27	1	26440	31	2	27148
135N - 170E		4644	9	9	30	2	25538	32	2	26536	31	2	25602	34	2	25880

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCi/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W. A. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 140N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
140N - 157E		4608	8	8	25	2	28002	34	2	30274	31	2	28672	63	1	26140
140N - 160E		4646	10	10	28	2	26788	36	2	28752	28	2	26684	39	1	26688
140N - 165E		4310	10	10	22	2	26188	34	2	27172	33	2	27758	26	2	27250
140N - 170E		4576	10	10	38	2	25678	30	2	26472	30	2	27490	30	2	27298

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCi/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W. A. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 145N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
145N - 157E		4490	10	8	22	2	25132	13	2	22342	92	1	23278	65	1	26164
145N - 160E		4528	9	10	33	2	25566	24	1	23146	91	1	24650	47	1	21144
145N - 165E		4294	9	9	33	2	27624	21	2	27628	29	2	27336	22	2	24530
145N - 170E		4618	10	10	33	2	25538	26	2	26842	31	2	27128	31	2	27502

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W. A. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 150N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
150N - 157E		4346	9	9	26	1	20992	66	1	22188	47	1	20800	82	1	20364
150N - 160E		3726	8	7	24	2	22538	68	1	28002	62	1	20764	65	1	23068
150N - 165E		4664	9	9	42	2	25722	31	2	22946	47	2	25558	53	2	26222
150N - 170E		4664	9	8	23	2	26902	22	2	25718	21	2	26086	23	2	35712
150N - 172E		4852	10	10	26	2	26824	24	2	28588	23	2	26400	30	2	26498

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.A. Ayres

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 155N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
155N - 157E		3530	8	8	33	1	21786	56	1	19644	50	1	21170	41	2	21712
155N - 160E		3792	9	8	44	1	23188	76	1	22680	95	1	27468	117	1	21892
155N - 165E		4042	8	8	18	2	20780	38	1	24000	57	1	22092	41	1	23358
155N - 170E		4572	9	8	25	2	22538	29	2	22060	26	2	24436	36	2	24644
155N - 173E		4514	9	9	26	2	24744	25	3	28110	20	2	24548	26	2	25122

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCi/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.A. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 158N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
158N - 173E		4664	9	9	29	2	26044	82	2	28000	79	2	27026	24	2	25842

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCi/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.G. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 160N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
160N - 157E		3580	9	8	52	1	20870	32	1	19394	52	1	21974	85	1	29110
160N - 160E		3842	8	8	46	1	25448	62	1	19554	65	1	22760	66	1	22382
160N - 165E		4418	8	9	51	1	23156	38	2	22524	37	1	20526	36	2	18810
160N - 170E		4726	9	9	34	2	25726	29	2	23698	39	2	23642	23	2	22202

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.a. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 165N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
165N - 157E		3538	8	8	25	2	21134	74	1	19038	58	2	19972	43	1	25000
165N - 160E		3690	8	9	35	1	23256	37	1	17952	41	1	21490	138	1	17974
165N - 165E		3390	8	8	19	2	19724	74	1	22164	48	1	20948	46	1	22112

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.a. Rogers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 167N

Date: DECEMBER 14, 1994

Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
167N - 160E		3812	8	8	21	2	18468	35	1	18124	48	1	22040	45	2	21896

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220, LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCI/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W. A. Byers

CIMARRON CORPORATION, CIMARRON FACILITY

DESIGNATED AREA STOCKPILE CHARACTERIZATION

Sample Location: DAP #3

Grid Run #: 168N

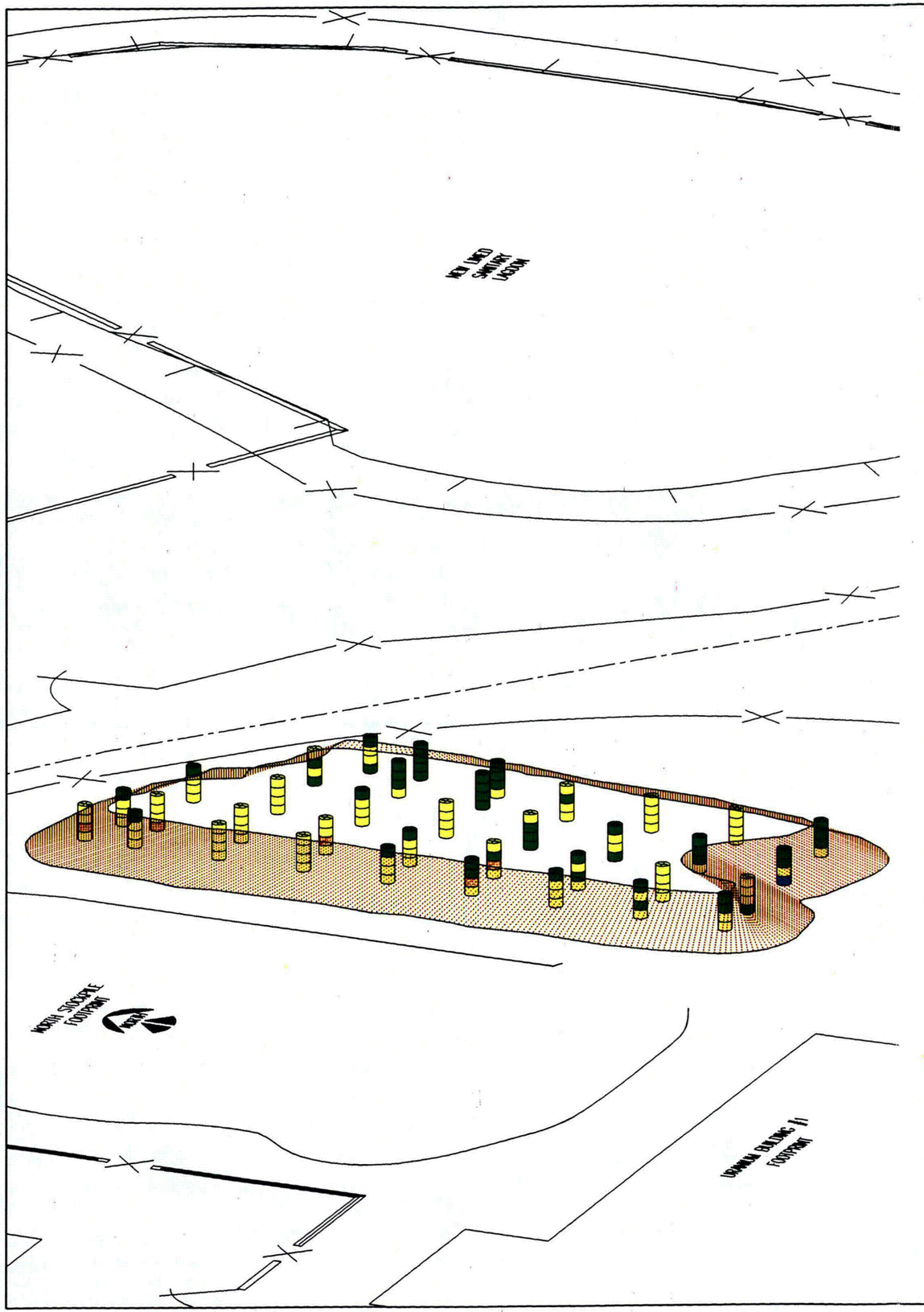
Date: DECEMBER 14, 1994

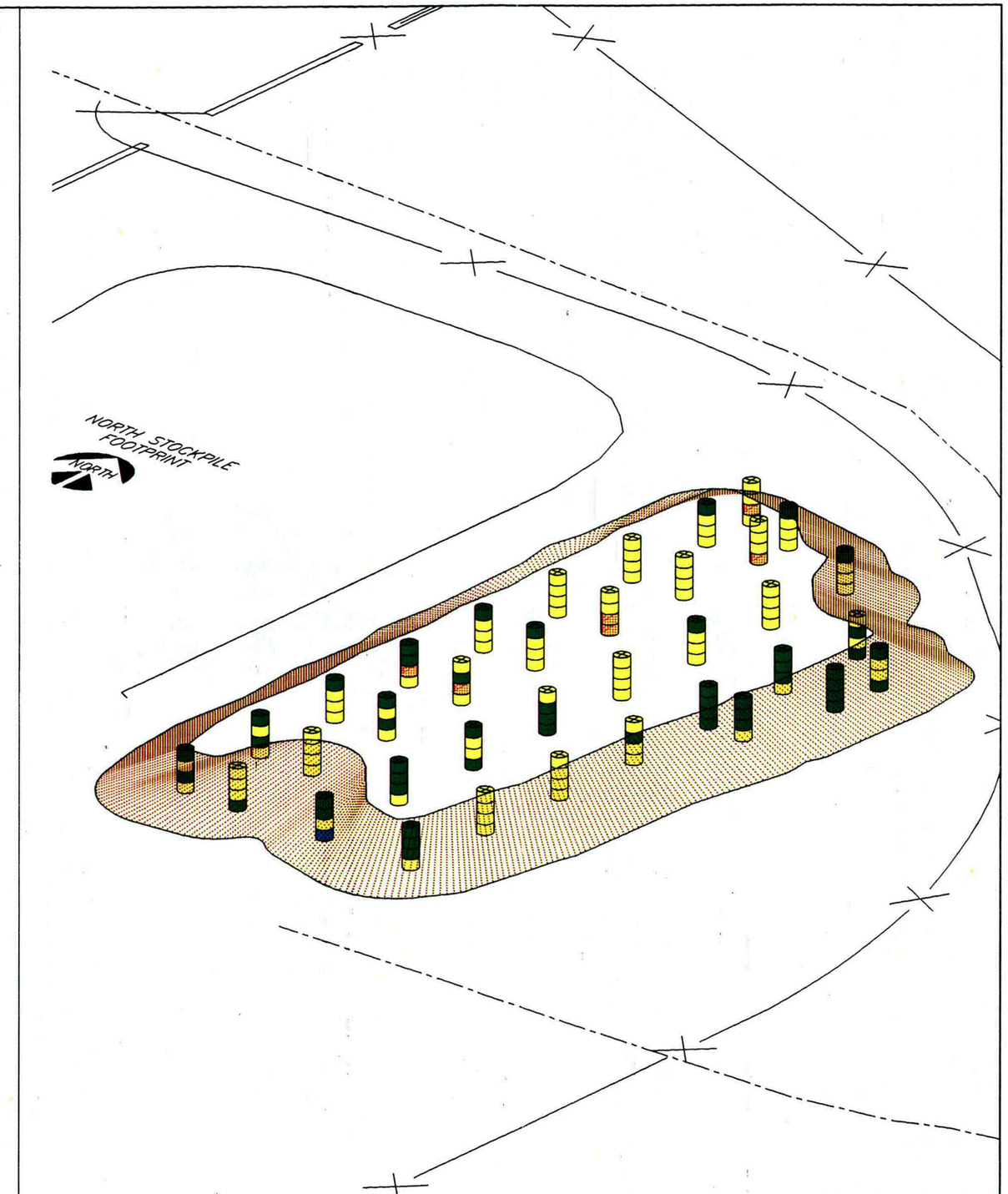
Grid Number	Elev.	3" Det. CPM	Micro "R"/HR I-M	Micro "R"/HR SUR	0 - .5M U	0 - .5M Th	0 - .5M Dirt Probe	.5M - 1M U	.5M - 1M Th	.5M - 1M Dirt Probe	1M - 1.5M U	1M - 1.5M Th	1M - 1.5M Dirt Probe	1.5M - 2.0M U	1.5M - 2.0M TH	1.5M - 2.0M Dirt Probe
168N - 157E		3616	8	8	30	1	16532	35	1	16220	164	1	18584	50	2	31936

INSTRUMENTS	RESULTS IN	BACKGROUND
LUDLUM MICRO "R" METER - MODEL 19 - S/N - 111299	ur/hr	7
LUDLUM 2220; LEAD SHIELDED 3" X 1/2" NaI DETECTOR S/N - 48395	CPM	3218
LUDLUM 2220, 1 1/2" X 4" DETECTOR, DIRT PROBE - S/N - 50056	CPM	21500
CIMARRON SOIL COUNTER, 4" X 4" X 16" NaI DETECTOR	pCi/g	6

SITE BACKGROUND OF 6 pCi/g U & 1.5 pCi/g Th NOT SUBTRACTED

REVIEWED BY: W.A. Rogers





LEGEND

- 0 TO .5 M — 1 - 29 pCi/g U
- .5 TO 1 M — 30 - 89 pCi/g U
- 1 TO 1.5 M — 90 - 249 pCi/g U
- 1.5 TO 2 M — > 250 pCi/g U
- PILE SLOPE - NO SAMPLE

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED STOCKPILE #3
CHARACTERIZATION SOIL SAMPLE RESULTS (1994)
SOIL SAMPLE ALIQUOTS: 0 TO 2M DEEP

CLIENT DRAWING NO.

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:
JE	2/17/95	JA	3/1/95	KM	NONE

JOB NO.	DRAWING NO.	REV.
	94MOD3SS	0

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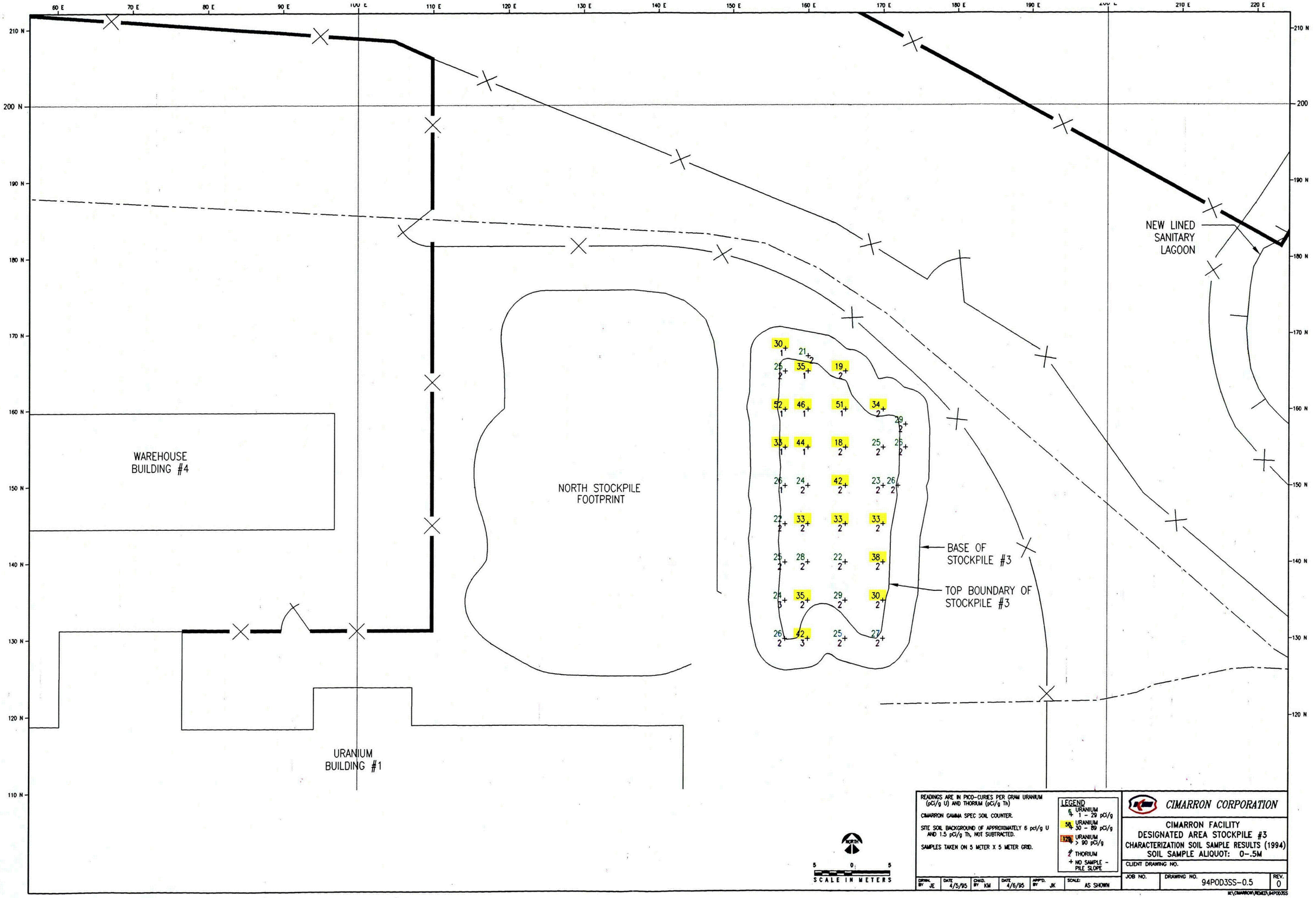

READINGS ARE IN PICO-CURIES PER GRAM URANIUM (pCi/g U) AND THORIUM (pCi/g Th)

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROXIMATELY 6 pci/g U AND 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON 5 METER X 5 METER GRID.

LEGEND
- 6 URANIUM 1 - 29 pCi/g
- 58 URANIUM 30 - 89 pCi/g
- 124 URANIUM > 90 pCi/g
- 2 THORIUM
- + NO SAMPLE - PILE SLOPE

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION SOIL SAMPLE RESULTS (1994)
SOIL SAMPLE ALIQUOT: 0-.5M

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:	CLIENT DRAWING NO.	JOB NO.	DRAWING NO.	REV.
JE	4/5/95	KM	4/6/95	JK	AS SHOWN			94POD3SS-0.5	0

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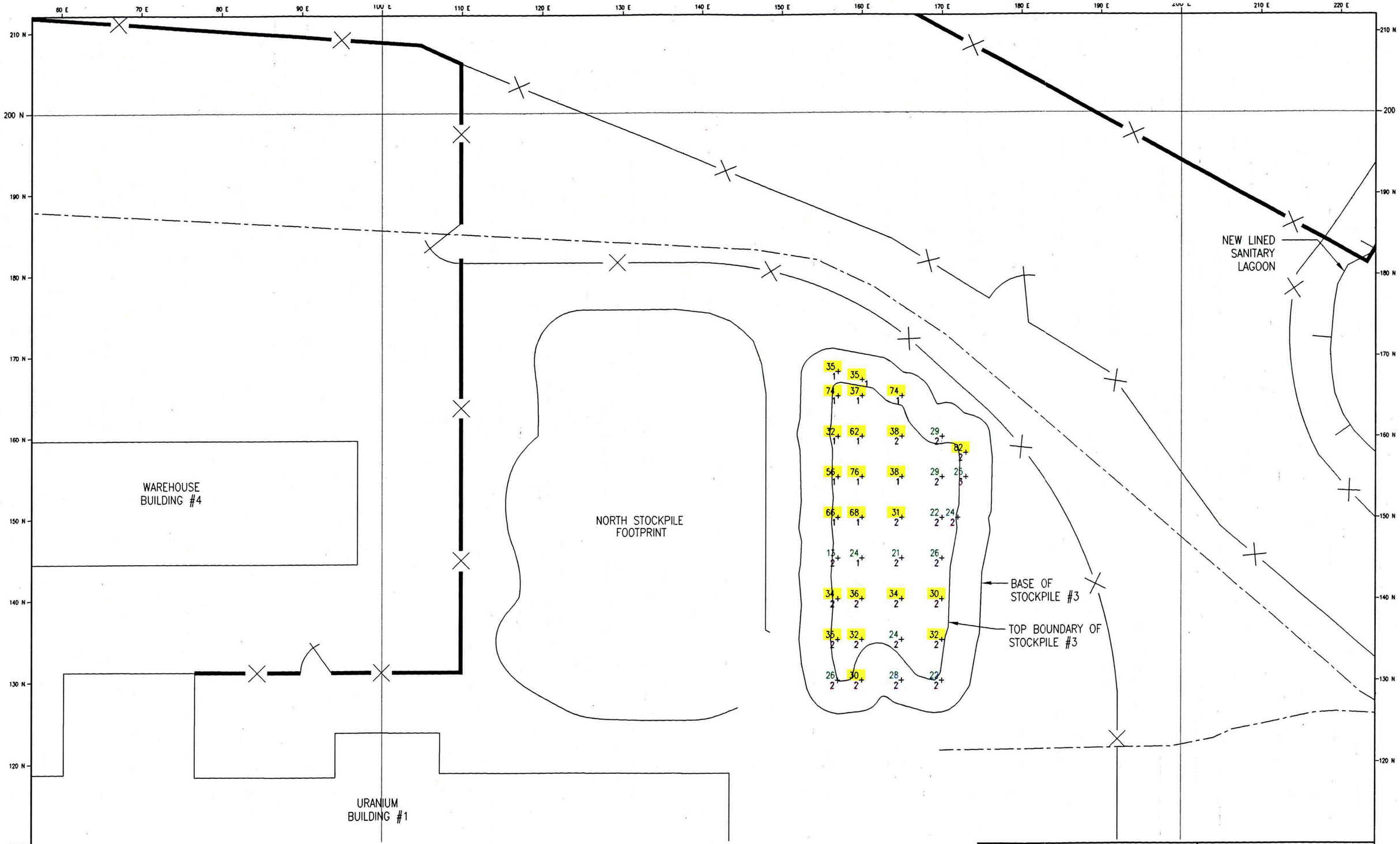

READINGS ARE IN PICO-CURIES PER GRAM URANIUM (pCi/g U) AND THORIUM (pCi/g Th)

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROXIMATELY 6 pci/g U AND 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON 5 METER X 5 METER GRID.

LEGEND
- 6 + URANIUM 1 - 29 pCi/g
- 58 + URANIUM 30 - 89 pCi/g
- 2 + URANIUM > 90 pCi/g
- 2 THORIUM
- + NO SAMPLE - PILE SLOPE

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION SOIL SAMPLE RESULTS (1994)
SOIL SAMPLE ALIQUOT: .5-1M

CLIENT DRAWING NO.

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:	JOB NO.	DRAWING NO.	REV.
JE	4/5/95	KM	4/6/95	JK	AS SHOWN		94POD3SS-1.0	0

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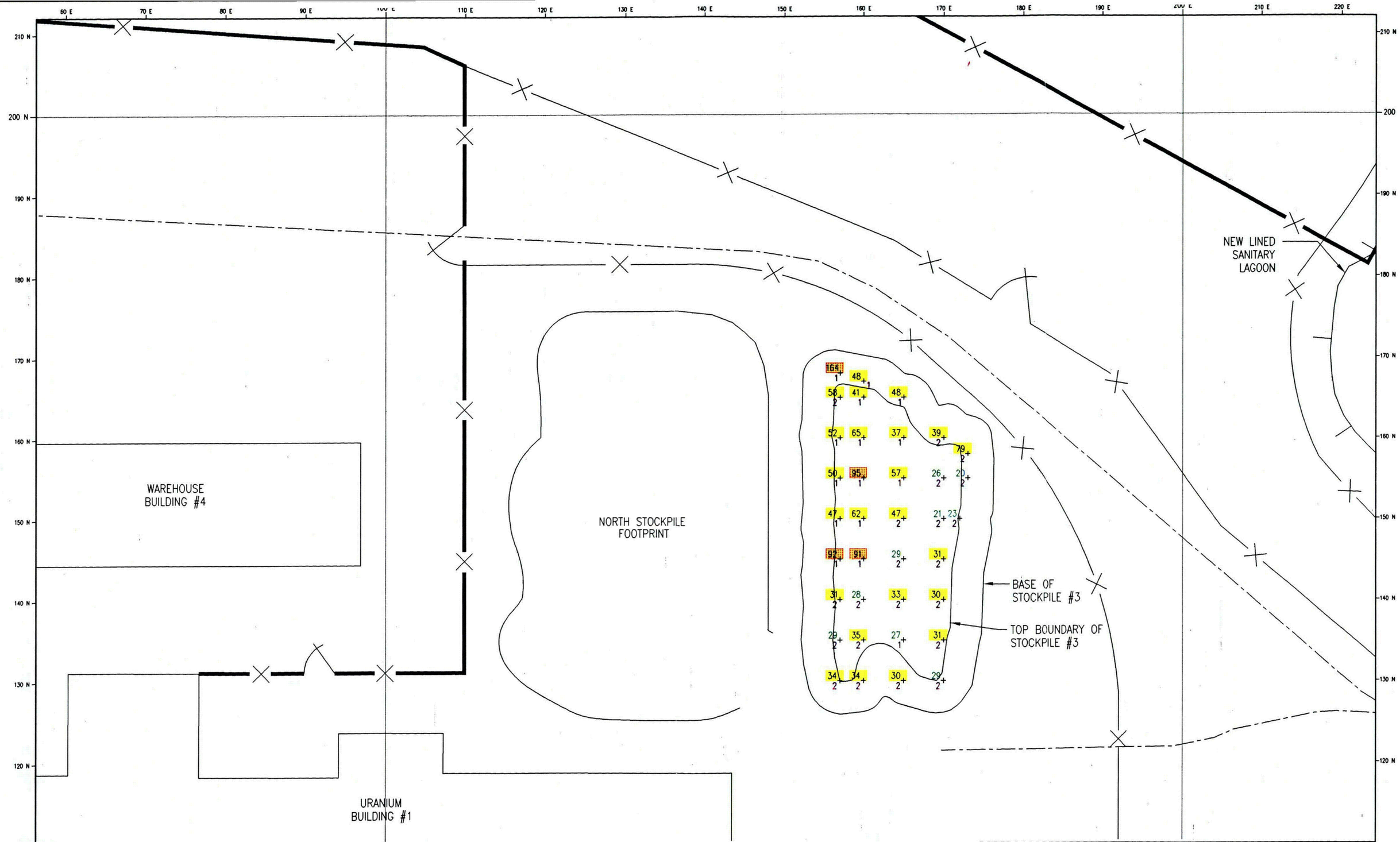

READINGS ARE IN PICO-CURIES PER GRAM URANIUM (pCi/g U) AND THORIUM (pCi/g Th)

CIMARRON GAMMA SPEC SOIL COUNTER.

SITE SOIL BACKGROUND OF APPROXIMATELY 6 pci/g U AND 1.5 pCi/g Th, NOT SUBTRACTED.

SAMPLES TAKEN ON 5 METER X 5 METER GRID.

LEGEND
- URANIUM 1 - 29 pCi/g
- URANIUM 30 - 89 pCi/g
- URANIUM > 90 pCi/g
- THORIUM
- + NO SAMPLE - PILE SLOPE

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION SOIL SAMPLE RESULTS (1994)
SOIL SAMPLE ALIQUOT: 1-1.5M

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:	CLIENT DRAWING NO.	JOB NO.	DRAWING NO.	REV.
JE	4/5/95	KM	4/6/95	JK	AS SHOWN			94POD3SS-1.5	0

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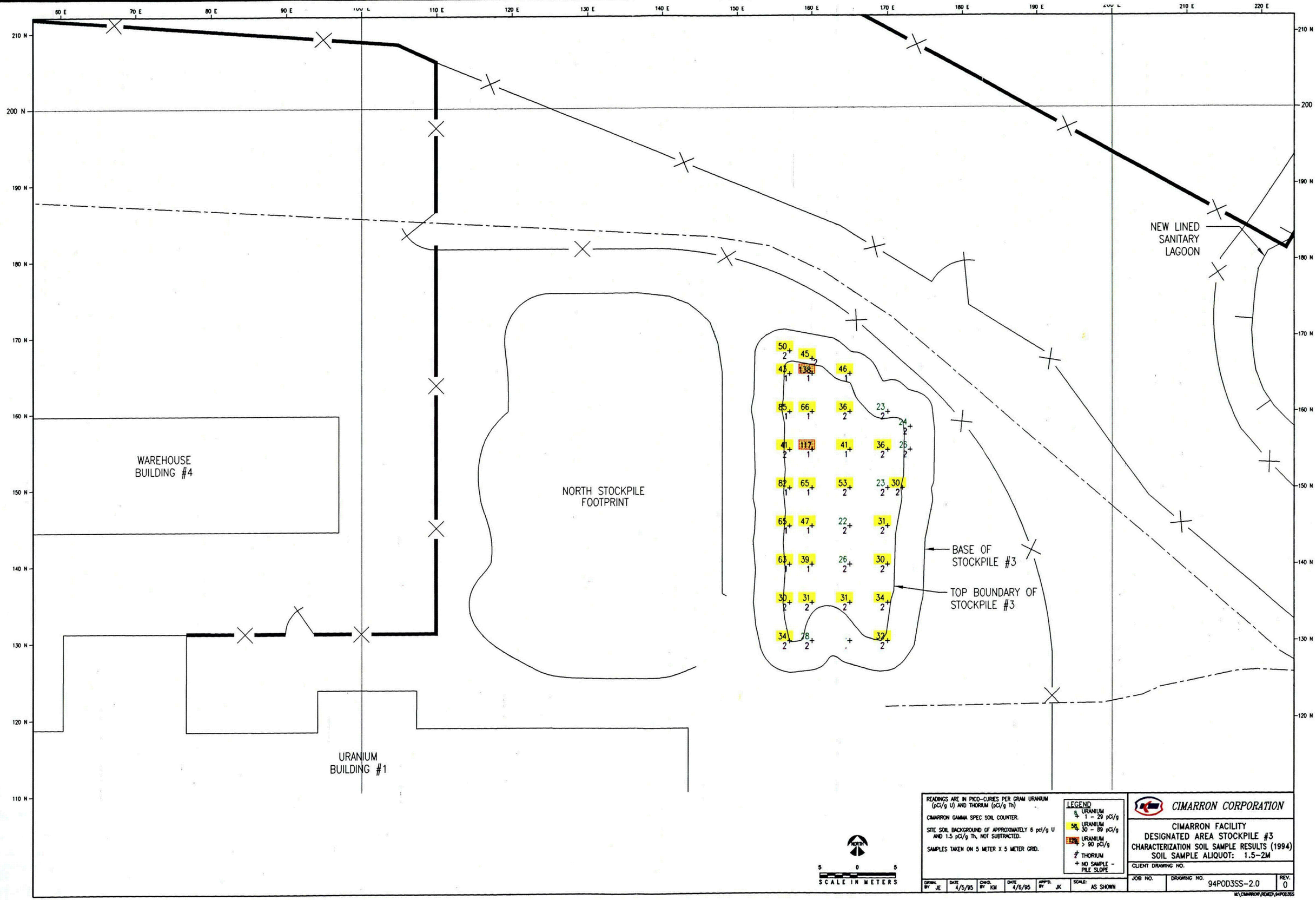
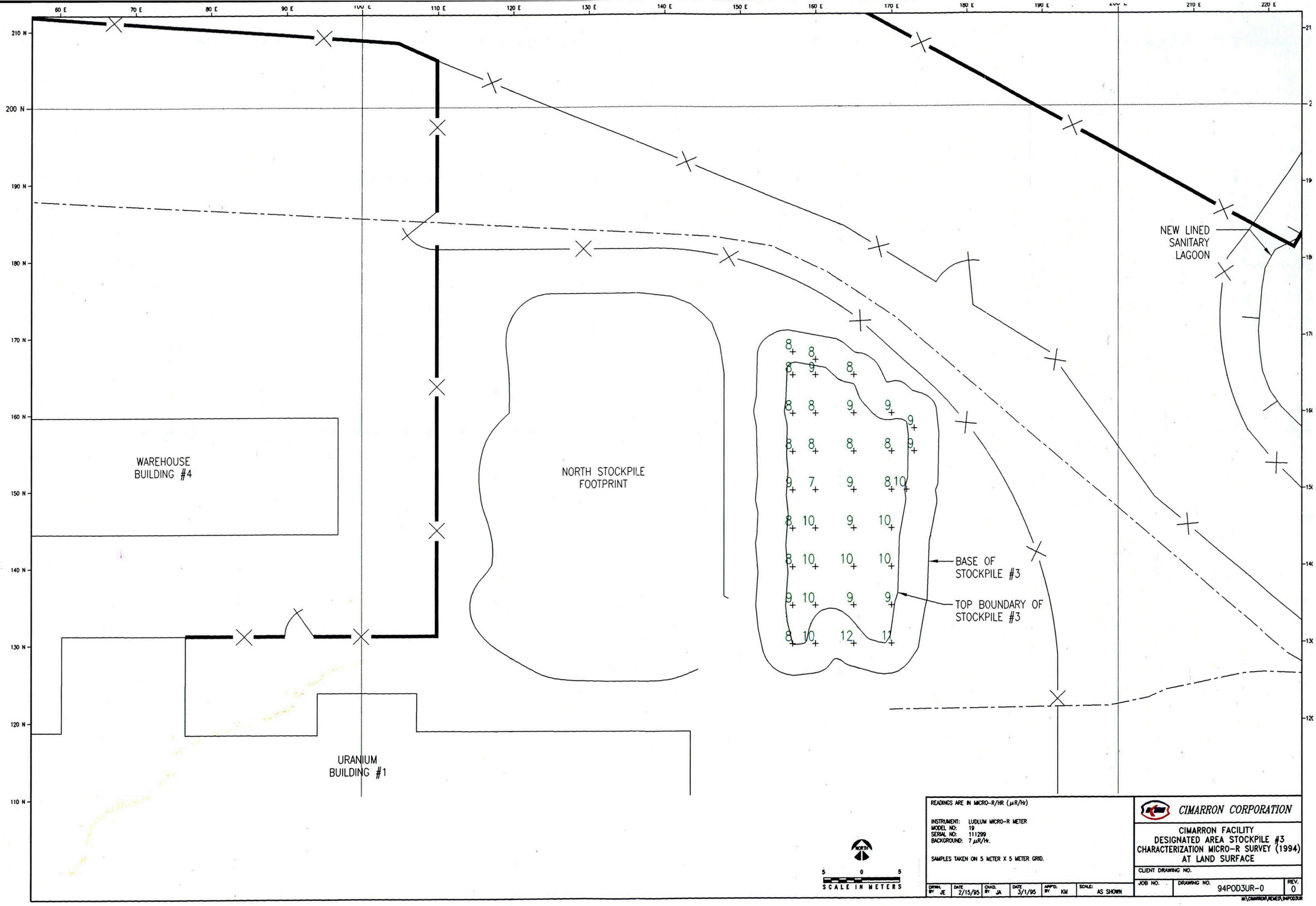

WAREHOUSE BUILDING #4
URANIUM BUILDING #1
NORTH STOCKPILE FOOTPRINT
NEW LINED SANITARY LAGOON
BASE OF STOCKPILE #3
TOP BOUNDARY OF STOCKPILE #3
NORTH
SCALE IN METERS
READINGS ARE IN PICO-CURIES PER GRAM URANIUM (pCi/g U) AND THORIUM (pCi/g Th)
CIMARRON GAMMA SPEC SOIL COUNTER.
SITE SOIL BACKGROUND OF APPROXIMATELY 6 pci/g U AND 1.5 pCi/g Th, NOT SUBTRACTED.
SAMPLES TAKEN ON 5 METER X 5 METER GRID.
LEGEND
URANIUM 1 - 29 pCi/g
URANIUM 30 - 89 pCi/g
URANIUM > 90 pCi/g
THORIUM
NO SAMPLE - PILE SLOPE
CIMARRON CORPORATION
CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION SOIL SAMPLE RESULTS (1994)
SOIL SAMPLE ALIQUOT: 1.5-2M
CLIENT DRAWING NO.
JOB NO.
DRAWING NO. 94POD3SS-2.0
REV. 0
DRWN. BY JE
DATE 4/5/95
CHKD. BY KM
DATE 4/6/95
APP'D. BY JK
SCALE: AS SHOWN



READINGS ARE IN MICRO-R/HR (μR/Hr)

INSTRUMENT: LUDLUM MICRO-R METER
MODEL NO: 19
SERIAL NO: 111299
BACKGROUND: 7 μR/Hr.

SAMPLES TAKEN ON 5 METER X 5 METER GRID.

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:
JE	2/15/95	JA	3/1/95	KM	AS SHOWN

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION MICRO-R SURVEY (1994)
AT LAND SURFACE

CLIENT DRAWING NO.

JOB NO.	DRAWING NO.	REV.
	94POD3UR-0	0

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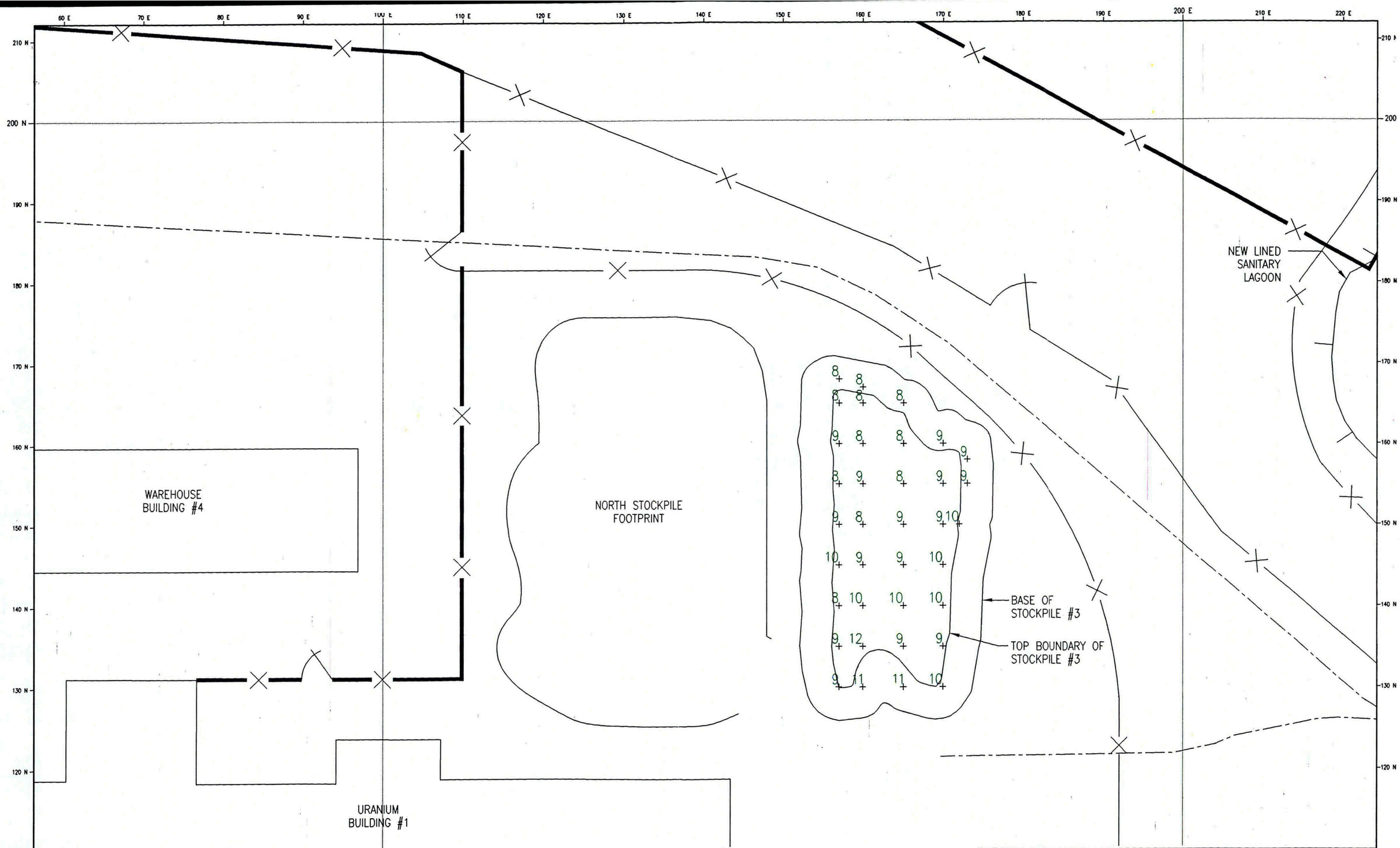


READINGS ARE IN MICRO-R/HR (μR/Hr)

INSTRUMENT: LUDLUM MICRO-R METER
MODEL NO: 19
SERIAL NO: 111299
BACKGROUND: 7 μR/Hr.

SAMPLES TAKEN ON 5 METER X 5 METER GRID.

DRWN. BY	DATE	CHK'D. BY	DATE	APP'D. BY	SCALE:
JE	2/15/95	JA	3/1/95	KW	AS SHOWN

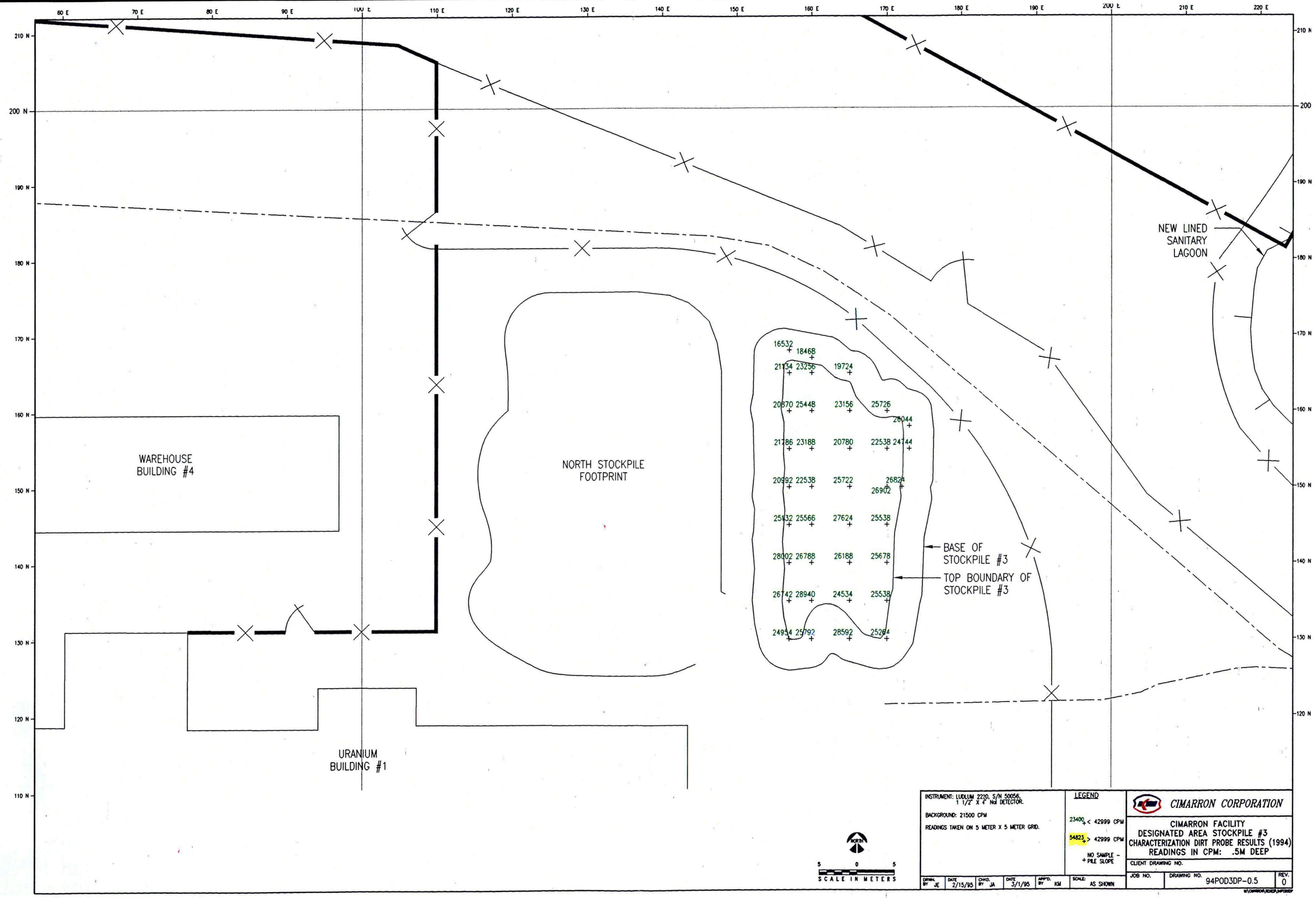
CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION MICRO-R SURVEY (1994)
AT ONE METER ABOVE SURFACE

CLIENT DRAWING NO.

JOB NO.	DRAWING NO.	REV.
	94POD3UR-1	0

M:\CIMARRON\REMED\94POD3UR



INSTRUMENT: LUDLUM 2220, S/N 50056, 1 1/2" X 4" NaI DETECTOR.

BACKGROUND: 21500 CPM

READINGS TAKEN ON 5 METER X 5 METER GRID.

LEGEND

23400 < 42999 CPM

54823 > 42999 CPM

NO SAMPLE - PILE SLOPE

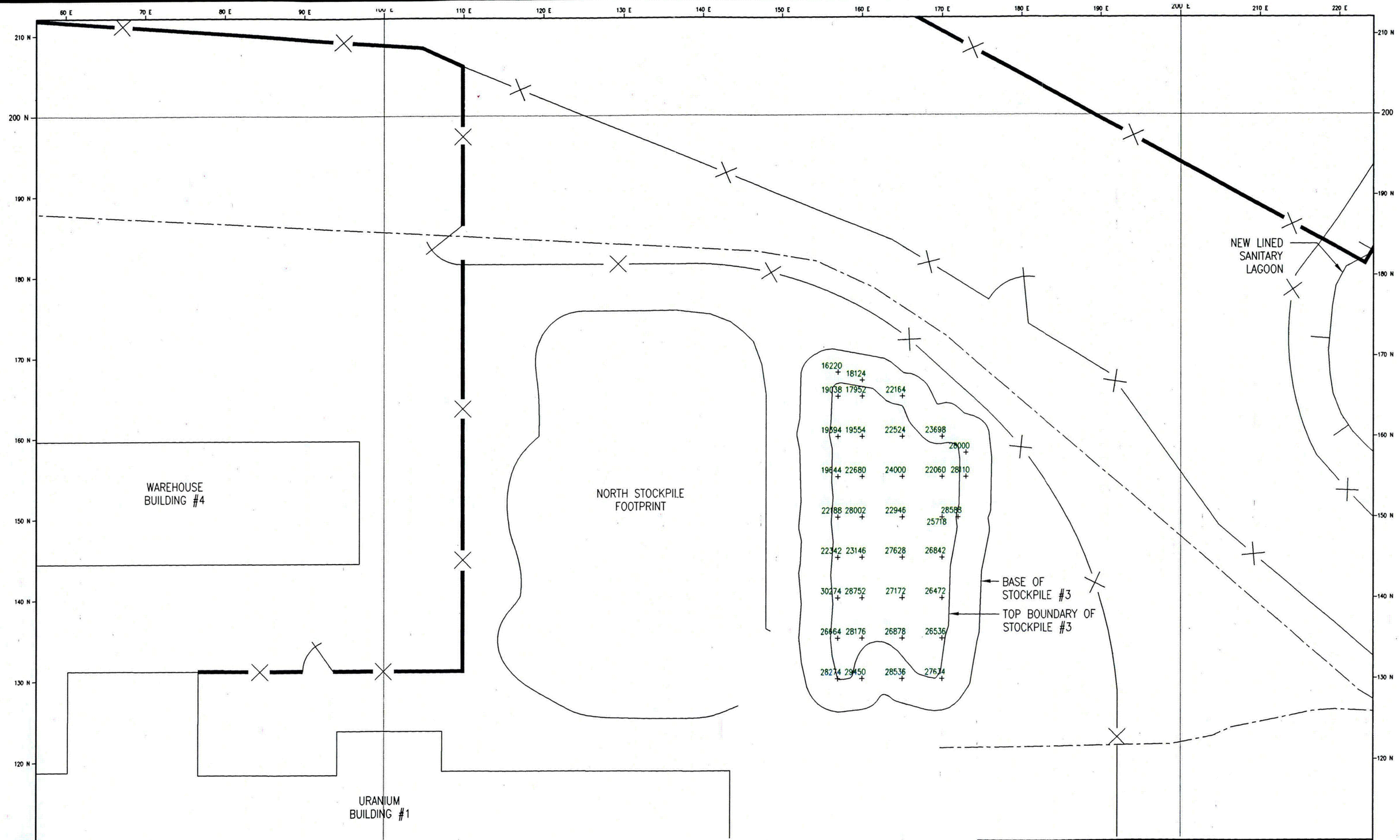
DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:
JE	2/15/95	JA	3/1/95	KM	AS SHOWN

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION DIRT PROBE RESULTS (1994)
READINGS IN CPM: .5M DEEP

CLIENT DRAWING NO.

JOB NO.	DRAWING NO.	REV.
	94POD3DP-0.5	0



INSTRUMENT: LUDLUM 2220, S/N 50056, 1 1/2" X 4" NaI DETECTOR.

BACKGROUND: 21500 CPM

READINGS TAKEN ON 5 METER X 5 METER GRID.

LEGEND

23400 < 42999 CPM

54823 > 42999 CPM

NO SAMPLE - + PILE SLOPE

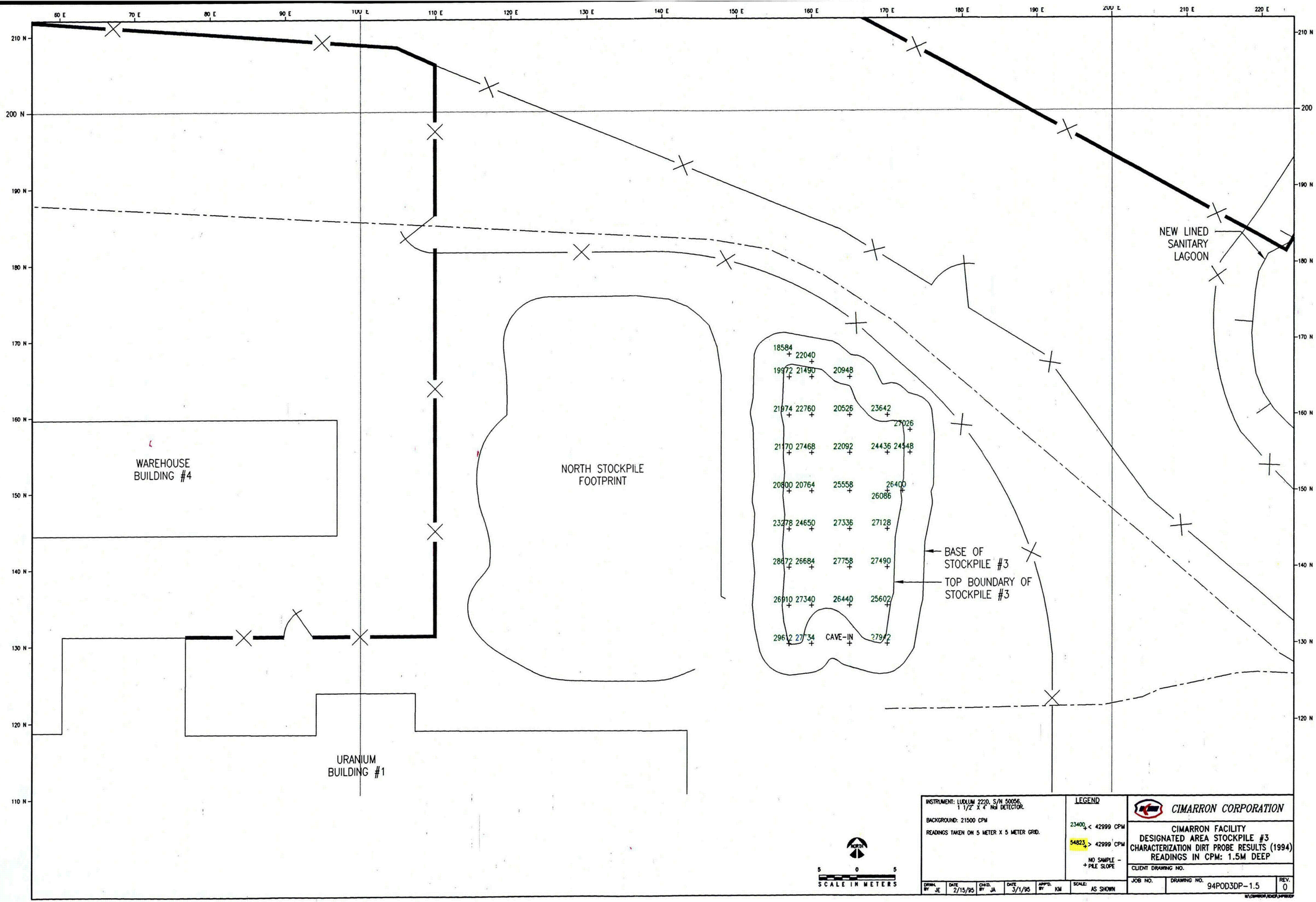
DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:
JE	2/15/95	JA	3/1/95	KM	AS SHOWN

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION DIRT PROBE RESULTS (1994)
READINGS IN CPM: 1.0M DEEP

CLIENT DRAWING NO.

JOB NO.	DRAWING NO.	REV.
	94POD3DP-1.0	0



INSTRUMENT: LUDLUM 2220, S/N 50056, 1 1/2" X 4" NaI DETECTOR.

BACKGROUND: 21500 CPM

READINGS TAKEN ON 5 METER X 5 METER GRID.

LEGEND

23400 < 42999 CPM

54823 > 42999 CPM

NO SAMPLE - + PILE SLOPE

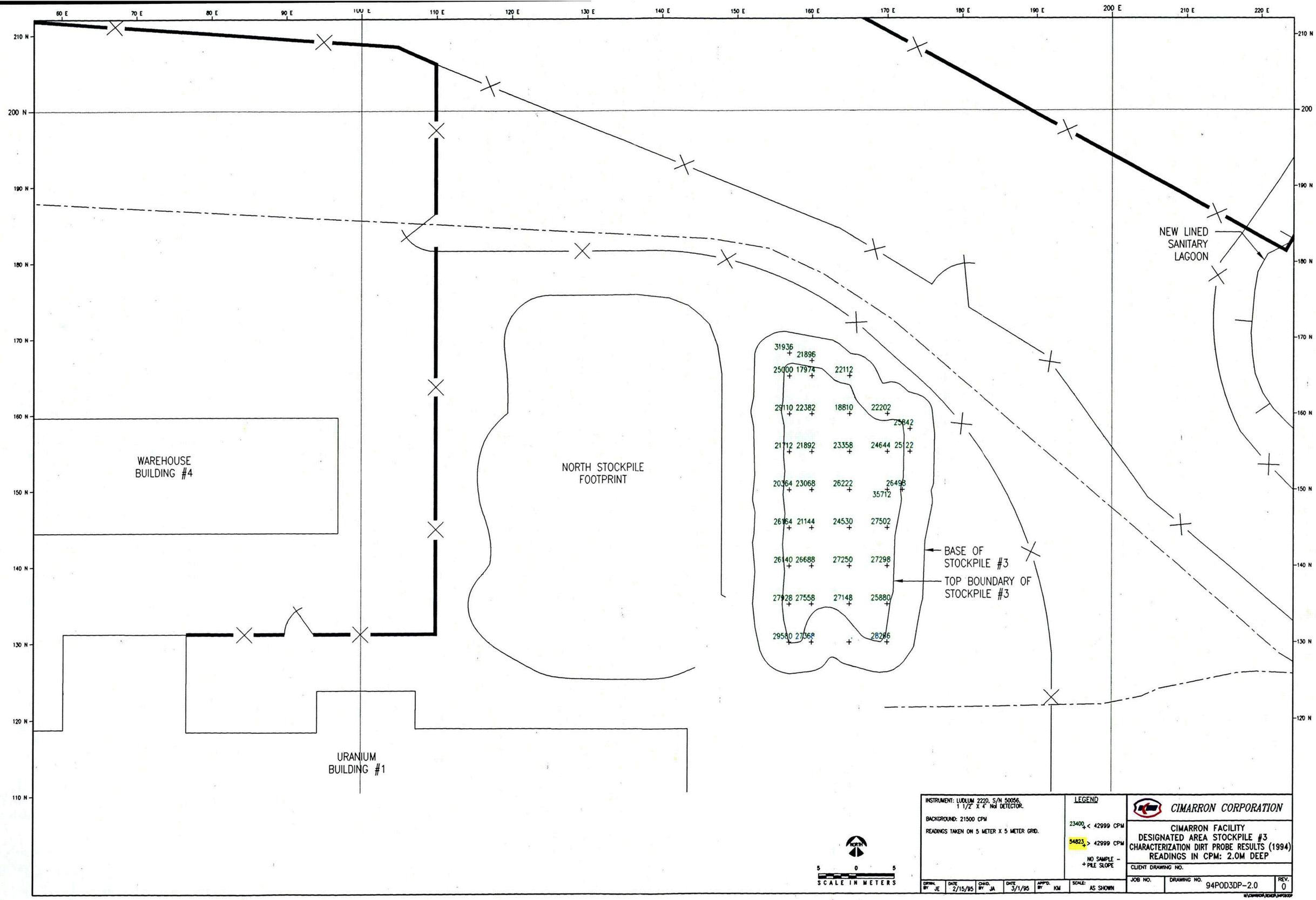
DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:
JE	2/15/95	JA	3/1/95	KM	AS SHOWN

CIMARRON CORPORATION

CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION DIRT PROBE RESULTS (1994)
READINGS IN CPM: 1.5M DEEP

CLIENT DRAWING NO.

JOB NO.	DRAWING NO.	REV.
	94POD3DP-1.5	0



INSTRUMENT: LUDLUM 2220, S/N 50056, 1 1/2" X 4" NaI DETECTOR.

BACKGROUND: 21500 CPM

READINGS TAKEN ON 5 METER X 5 METER GRID.

LEGEND

23400 < 42999 CPM

54823 > 42999 CPM

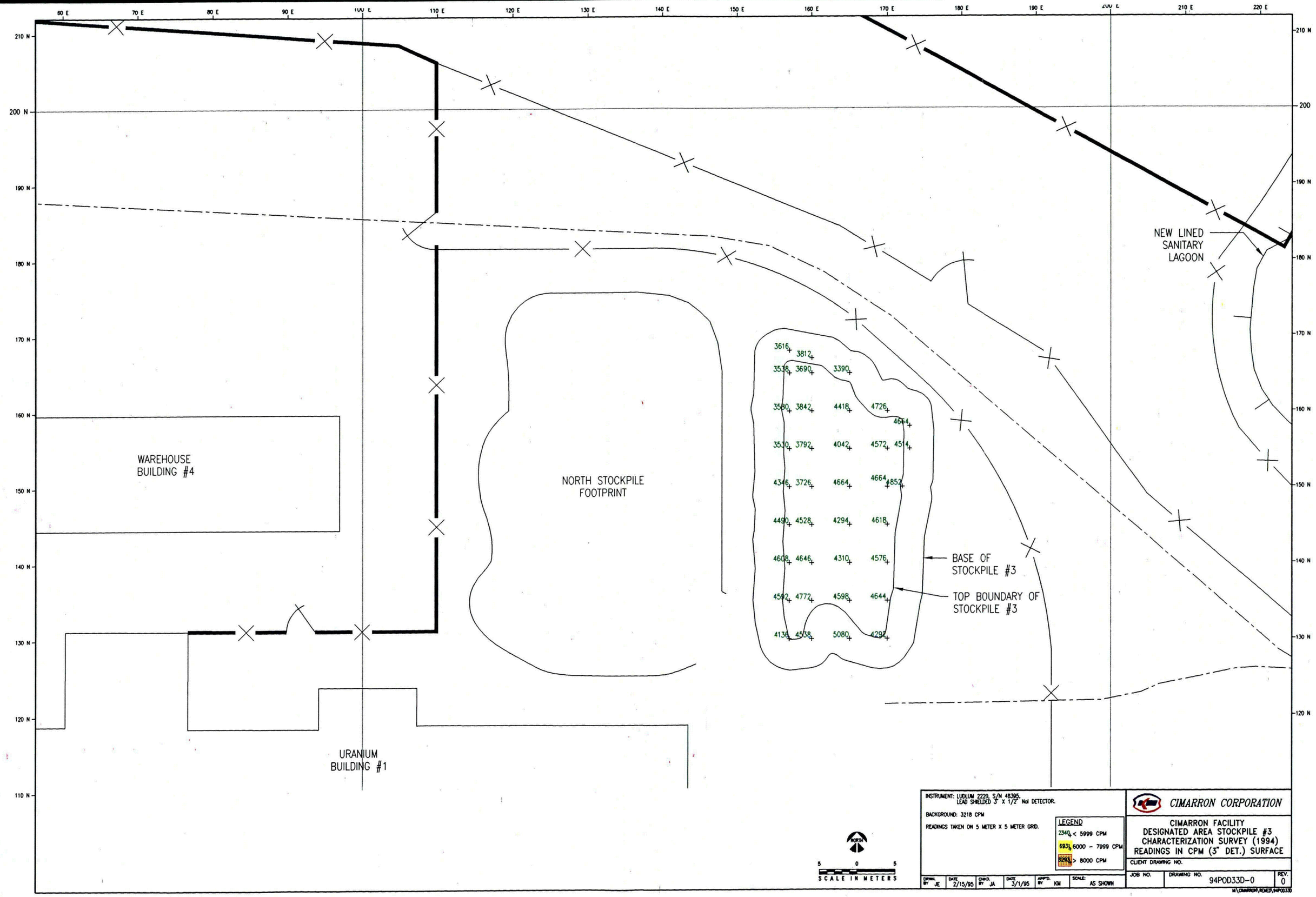
NO SAMPLE - PILE SLOPE

CIMARRON CORPORATION

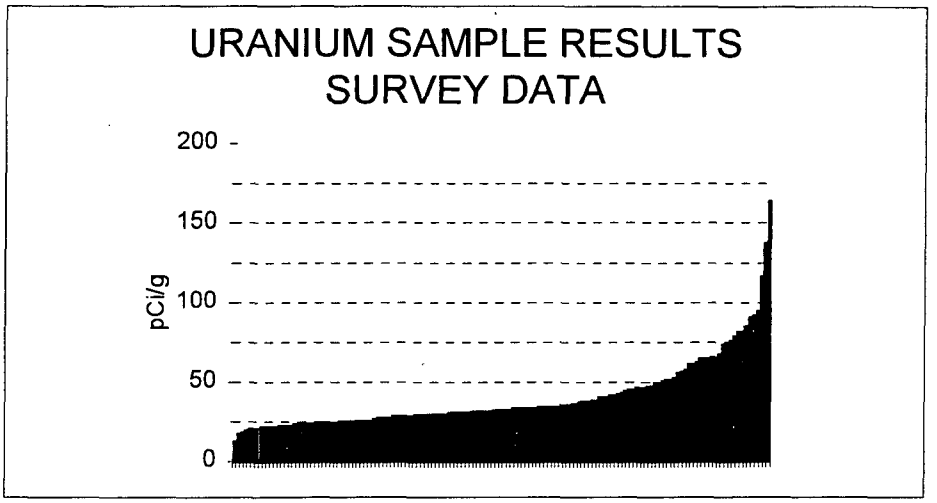
CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION DIRT PROBE RESULTS (1994)
READINGS IN CPM: 2.0M DEEP

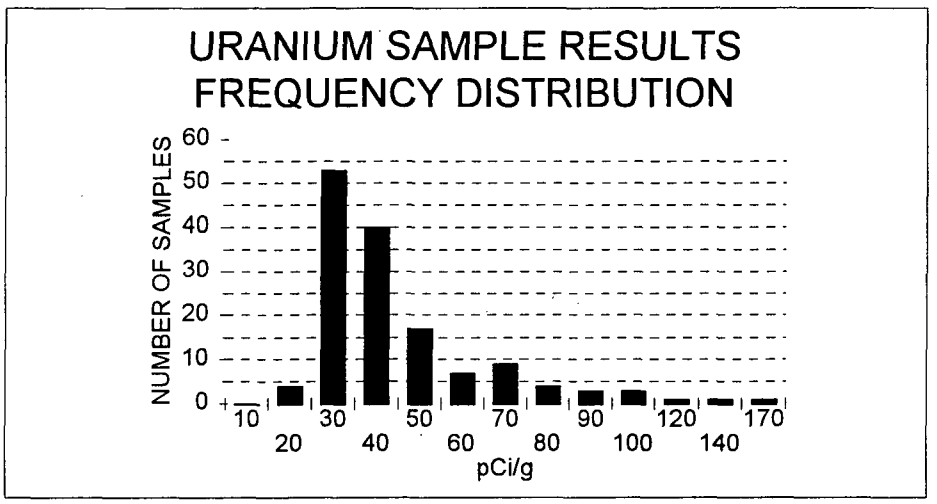
CLIENT DRAWING NO.

DRWN. BY	DATE	CHKD. BY	DATE	APP'D. BY	SCALE:	JOB NO.	DRAWING NO.	REV.
JE	2/15/95	JA	3/1/95	KM	AS SHOWN		94POD3DP-2.0	0


60 E
70 E
80 E
90 E
100 E
110 E
120 E
130 E
140 E
150 E
160 E
170 E
180 E
190 E
200 E
210 E
220 E
210 N
200 N
190 N
180 N
170 N
160 N
150 N
140 N
130 N
120 N
110 N
WAREHOUSE BUILDING #4
NORTH STOCKPILE FOOTPRINT
URANIUM BUILDING #1
NEW LINED SANITARY LAGOON
BASE OF STOCKPILE #3
TOP BOUNDARY OF STOCKPILE #3
3616 3812
3538 3690 3390
3580 3842 4418 4726 4664
3530 3792 4042 4572 4514
4346 3726 4664 4664 4852
4490 4528 4294 4618
4608 4646 4310 4576
4592 4772 4598 4644
4136 4538 5080 4292
NORTH
5 0 5
SCALE IN METERS
INSTRUMENT: LUDLUM 2220, S/N 48395.
LEAD SHIELDED 3" X 1/2" NaI DETECTOR.
BACKGROUND: 3218 CPM
READINGS TAKEN ON 5 METER X 5 METER GRID.
LEGEND
2340 < 5999 CPM
6933 6000 - 7999 CPM
> 8000 CPM
DRWN. BY JE
DATE 2/15/95
CHKD. BY JA
DATE 3/1/95
APP'D. BY KM
SCALE: AS SHOWN
CIMARRON CORPORATION
CIMARRON FACILITY
DESIGNATED AREA STOCKPILE #3
CHARACTERIZATION SURVEY (1994)
READINGS IN CPM (3" DET.) SURFACE
CLIENT DRAWING NO.
JOB NO.
DRAWING NO.
94POD33D-0
REV.
0

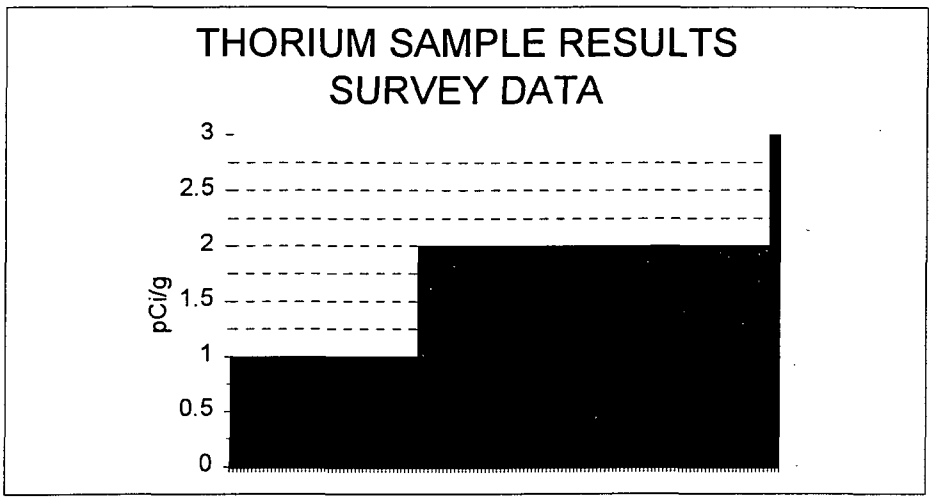
DAP-3 STOCKPILE CHARACTERIZATION
CIMARRON SOIL COUNTER
URANIUM SOIL SAMPLE RESULTS
SITE BACKGROUND OF 6 pCi/g URANIUM NOT SUBTRACTED
DECEMBER, 1994

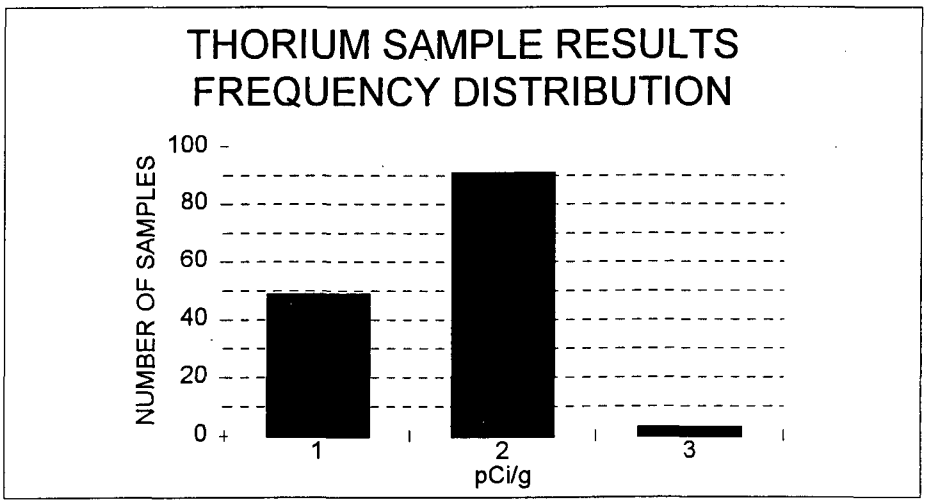




NUMBER OF SAMPLES	143
AVERAGE READING	40
MINIMUM READING	13
MAXIMUM READING	164
STANDARD DEVIATION	22

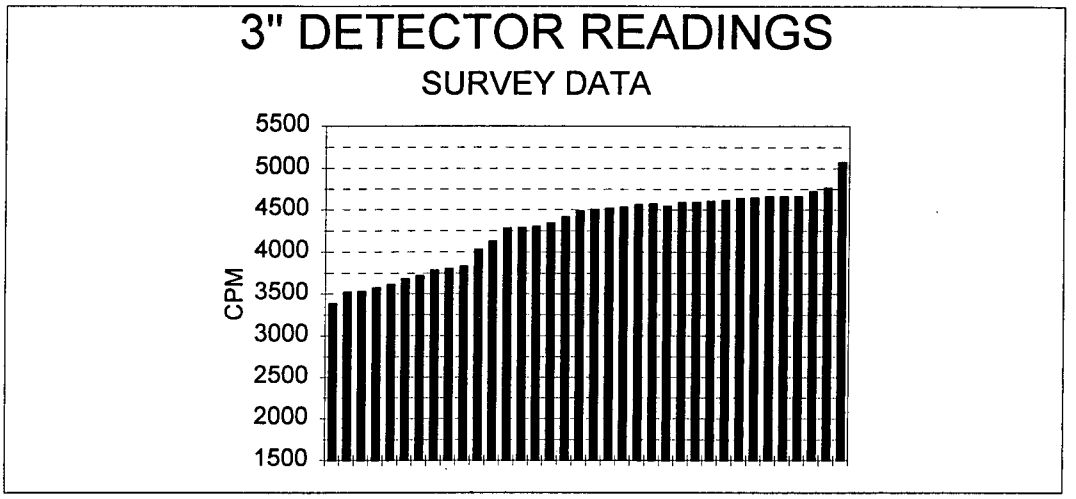
DAP-3 STOCKPILE CHARACTERIZATION
CIMARRON SOIL COUNTER
THORIUM SOIL SAMPLE RESULTS
SITE BACKGROUND OF 1.5 pCi/g Th NOT SUBTRACTED
DECEMBER, 1994

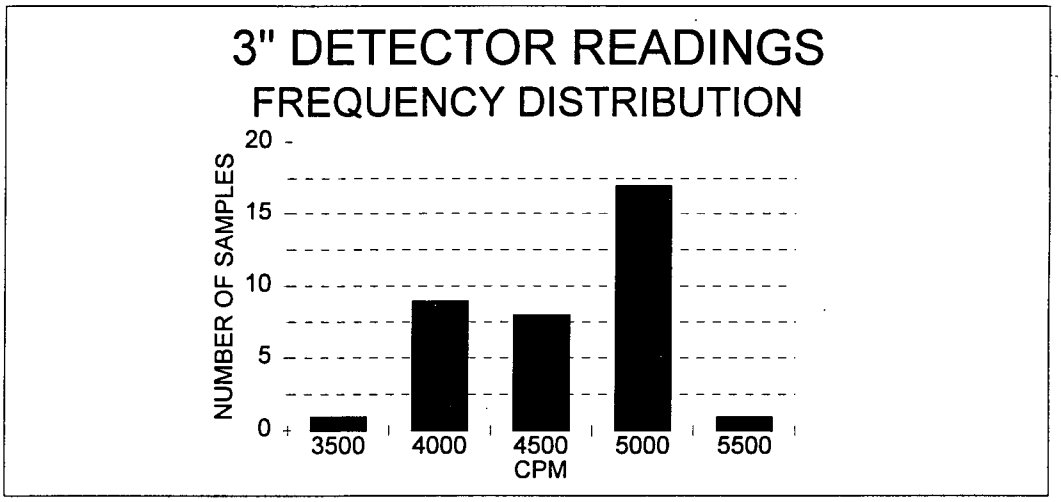




NUMBER OF SAMPLES	143
AVERAGE READING	2
MINIMUM READING	1
MAXIMUM READING	3
STANDARD DEVIATION	1

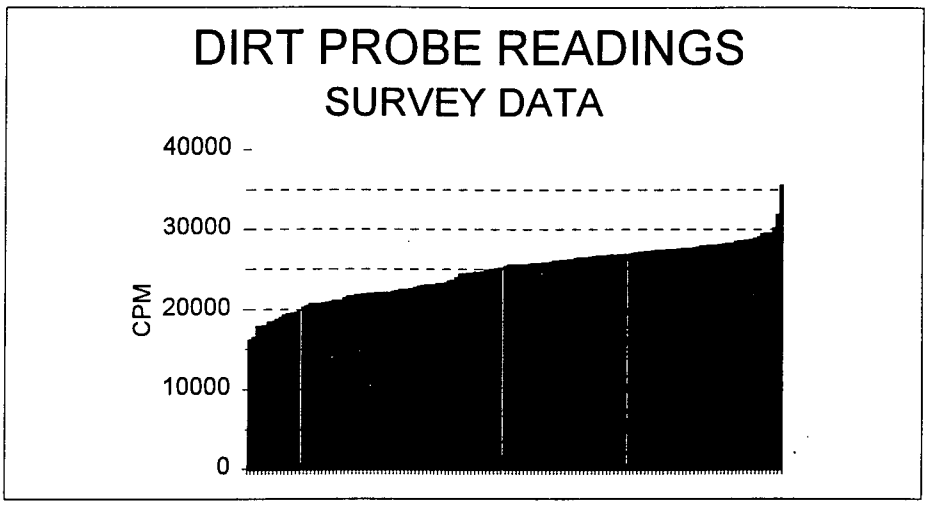
DAP-3 STOCKPILE CHARACTERIZATION
GROSS GAMMA READINGS IN CPM
LUDLUM MODEL 2220 S/N 48395
LEAD SHIELDED 3" X 1/2" NaI DETECTOR
BACKGROUND: 3218 CPM
DECEMBER, 1994

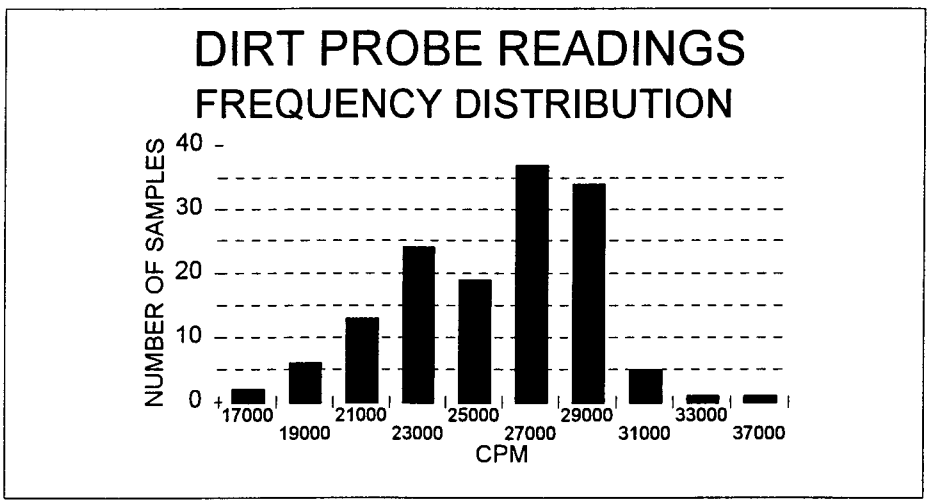




NUMBER OF READINGS	36
AVERAGE READING	4290
MINIMUM READING	3390
MAXIMUM READING	5080
STANDARD DEVIATION	439

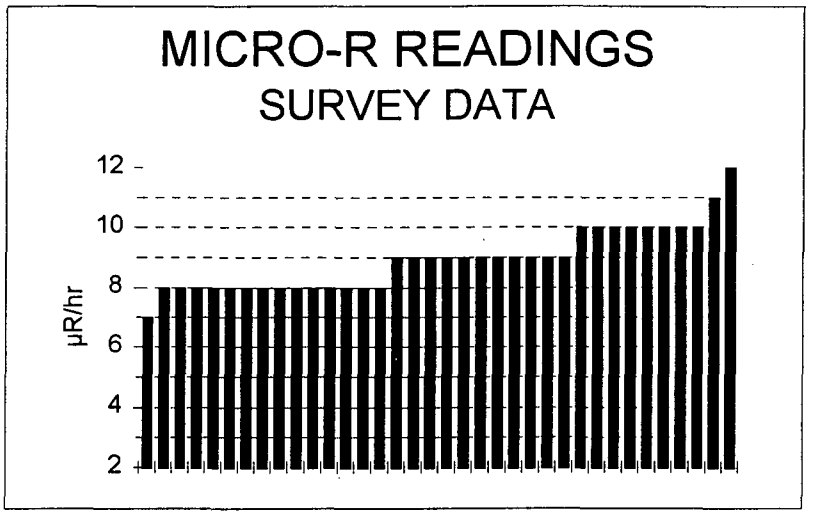
DAP-3 STOCKPILE CHARACTERIZATION
DIRT PROBE GAMMA READINGS IN CPM
LUDLUM MODEL 2220 S/N 50056
1 1/2" X 4" NaI, PVC ENCASED GAMMA DETECTOR
BACKGROUND 21,500 CPM
DECEMBER, 1994

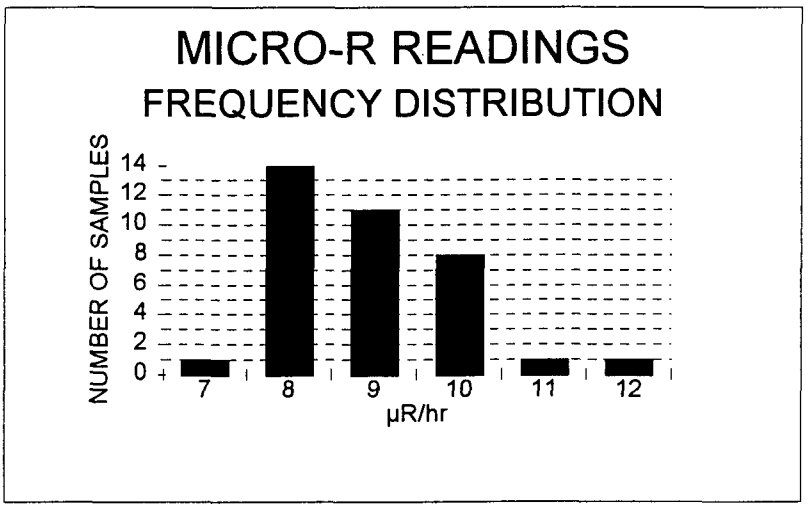




NUMBER OF READINGS	142
AVERAGE READING	24775
MINIMUM READING	16220
MAXIMUM READING	35712
STANDARD DEVIATION	3312

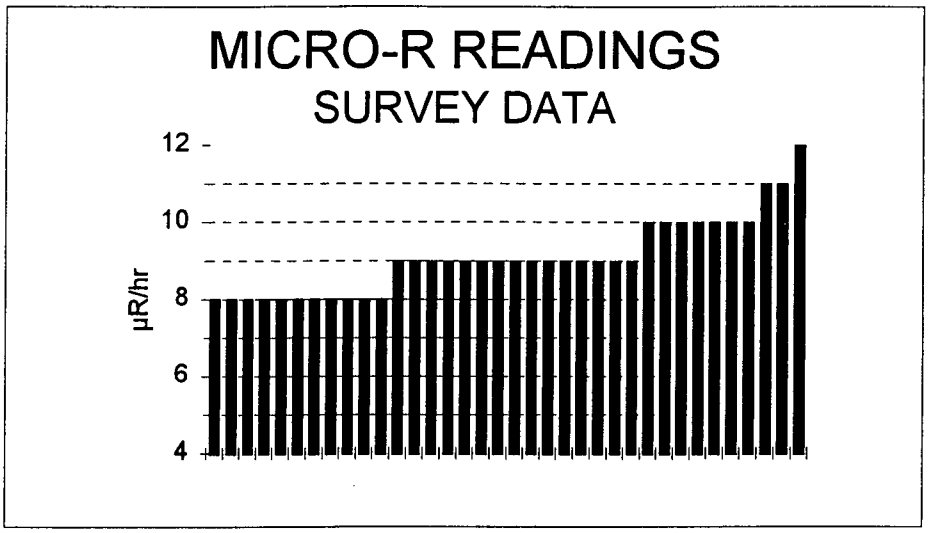
DAP-3 STOCKPILE CHARACTERIZATION
MICRO-R METER READINGS AT SURFACE
LUDLUM MODEL 19 S/N 111299
RESULTS IN µR/hr
SITE BACKGROUND 7 µR/hr
DECEMBER, 1994

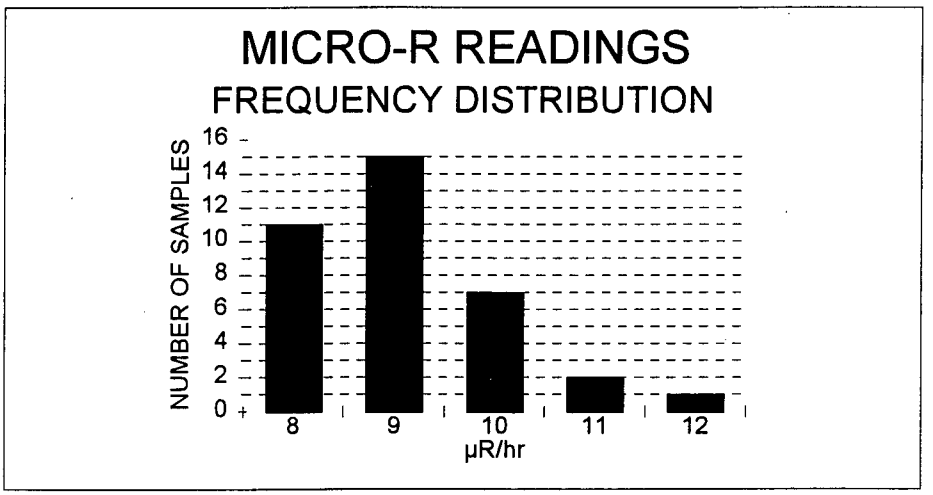




NUMBER OF READINGS	36
AVERAGE READING	9
MINIMUM READING	7
MAXIMUM READING	12
STANDARD DEVIATION	1

DAP-3 STOCKPILE CHARACTERIZATION
MICRO-R METER READINGS AT ONE METER ABOVE SURFACE
LUDLUM MODEL 19 S/N 111299
RESULTS IN µR/hr
SITE BACKGROUND 7 µR/hr
DECEMBER, 1994





NUMBER OF READINGS	36
AVERAGE READING	9
MINIMUM READING	8
MAXIMUM READING	12
STANDARD DEVIATION	1

Table 1-1

ENRICHED URANIUM pCi/g	BRANCH TECHNICAL POSITION PAPER OPTION NO. 1	2	3	4
SOLUBLE	30	100	--	1,000
INSOLUBLE	30	250	--	2,500

Note: Cimarron isolates and packages for shipment to a licensed low level waste burial site soils found with concentrations in excess of the option 2 limits.

Applying DRAFT NUREG-5849 averaging criteria, Option 2 material can be defined as having an average concentration of uranium less than or equal to 100 pCi/g with a maximum concentration less than or equal to 300 pCi/g.

At cimarron, the average concentration limit is based on 100% solubility, and may be adjusted upward, not to exceed the guideline value of 250 pCi/g, on the basis of solubility determined by a method acceptable to NRC staff.

TABLE 2-1

DAP-3 "HOT SPOTS" (ELEVATED LOCATIONS) EVALUATION
NUREG/CR-5849 METHODOLOGY

("HOT SPOTS" ARE AREAS >100pCi/gU)

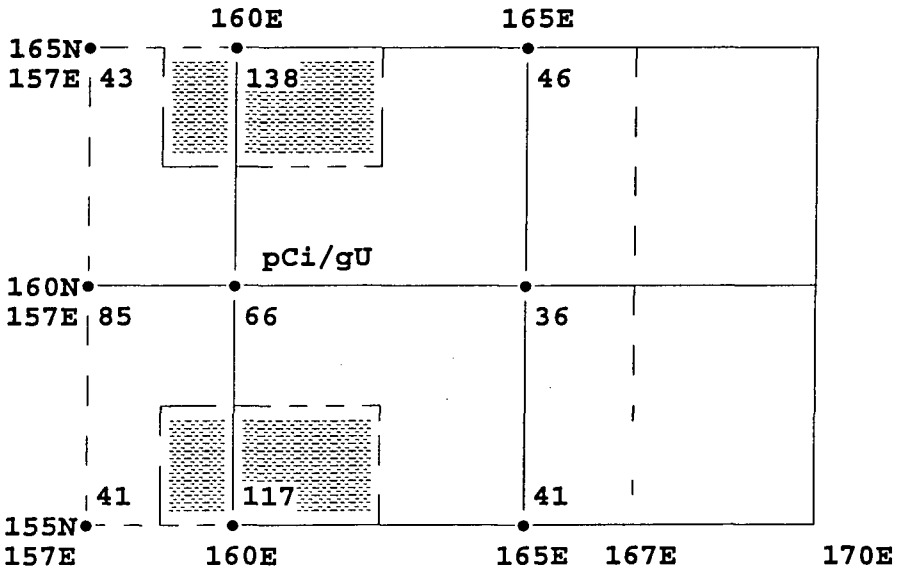
ELEVATED SAMPLE LOCATIONS

LOCATION	DEPTH	pCi/gU
155N - 160E	1.5 - 2.0 METERS	117
165N - 160E	1.5 - 2.0 METERS	138
168N - 157E	1.0 - 1.5 METERS	164

ELEVATED READINGS FOR LOCATIONS 155N-160E AND 165N-160E ARE WITHIN 10 METERS OF EACH OTHER AND THE "HOT SPOTS" AVERAGE CAN BE CALCULATED BY TWO DIFFERENT METHODS AS FOLLOWS:

165N-160E (138) pCi/gU AREA: 10 METERS^2
155N-160E (117) pCi/gU AREA: 10 METERS^2
TOTAL: (255) pCi/gU AREA: 20 METERS^2

Shaded areas represent elevated sample locations of interest.



NON ELEVATED LOCATIONS

LOCATION	pCi/gU
165N-157E	43
160N-157E	85
155N-157E	41
160N-160E	66
165N-165E	46
160N-165E	36
155N-165E	41
TOTAL:	358
AVERAGE:	51

$(100/A)^{0.5} = (100/20)^{0.5} = 2.24 \times 100 = 224$ pCi/gU
224 pCi/gU > 128 pCi/gU CRITERIA SATISFIED.

$\bar{X}w = 51[1-20/100] + 128[20/100] = 40.8 + 25.6 = 66.4$ pCi/gU

SUMMARY: NO EXCAVATION REQUIRED. NO VALUES ARE GREATER THAN 3X GUIDELINE. ELEVATED AREA OF 20 METERS^2 WITH CONCENTRATION OF 128 pCi/gU AVERAGE. $(100/A)^{0.5}$ LIMIT OF 224 pCi/gU IS SATISFIED. WEIGHTED AVERAGE OF 100 METERS^2 AREA IS 66.4 pCi/gU.

TABLE 2-2

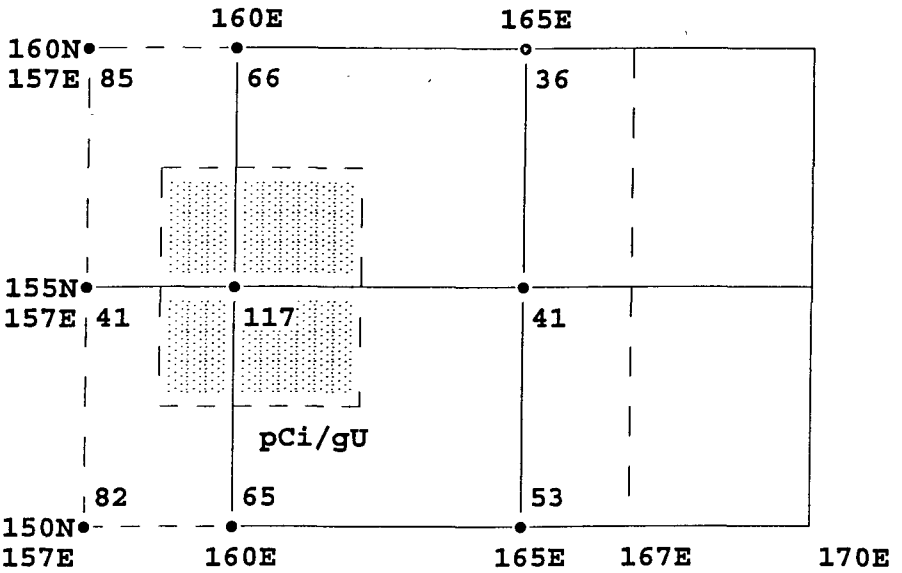
DAP-3 "HOT SPOTS" (ELEVATED LOCATIONS) EVALUATION
NUREG/CR-5849 METHODOLOGY

("HOT SPOTS" ARE AREAS >100 pCi/gU)

ELEVATED SAMPLE LOCATION

LOCATION	DEPTH	pCi/gU
155N - 160E	1.5 - 2.0 METERS	117

METHOD #2: EACH "ELEVATED SAMPLE RESULT IS CALCULATED SEPARATELY.
Shaded area represent the elevated location of interest.



NON ELEVATED LOCATIONS

LOCATION	pCi/gU
150N-157E	82
155N-157E	41
160N-157E	85
150N-160E	65
160N-160E	66
150N-165E	53
155N-165E	41
160N-165E	53
TOTAL:	486
AVERAGE:	61

ELEVATED LOCATION: 155N - 160E (117)pCi/gU AREA: (20 METERS^2)

$(100/A)^{0.5} = (100/20)^{0.5} = 2.24 \times 100 = 224$ pCi/gU
224 pCi/gU > 117 pCi/gU CRITERIA SATISFIED.

$\bar{X}w = 61[1-20/100] + 117[20/100] = 48.8 + 23.4 = 72.2$ pCi/gU

SUMMARY: NO EXCAVATION REQUIRED. NO VALUES ARE GREATER THAN 3X GUIDELINE. ELEVATED AREA OF 20 METERS^2 WITH CONCENTRATION OF 117 pCi/gU AVERAGE. $(100/A)^{0.5}$ LIMIT OF 224 pCi/gU IS SATISFIED. WEIGHTED AVERAGE OF 100 METERS^2 AREA IS 72.2 pCi/gU.

TABLE 2-3

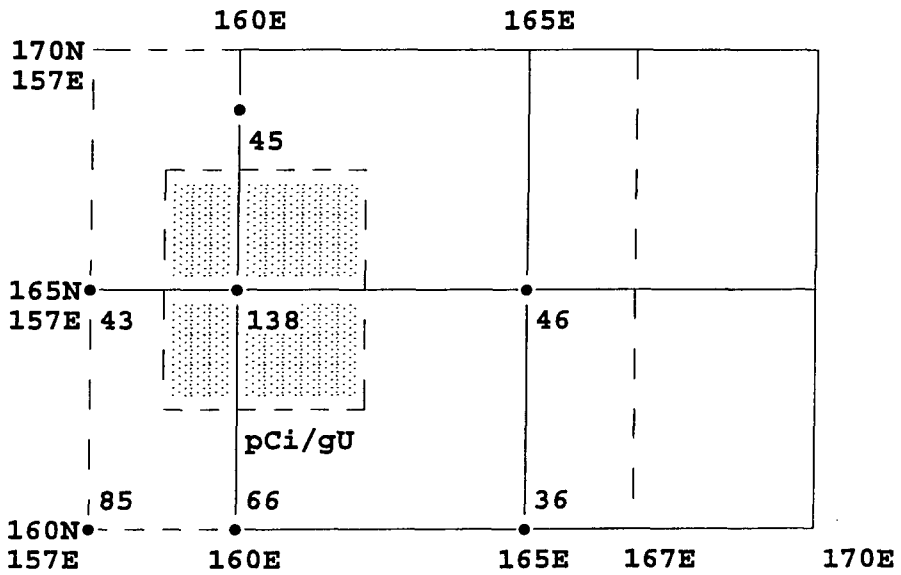
DAP-3 "HOT SPOTS" (ELEVATED LOCATIONS) EVALUATION
NUREG/CR-5849 METHODOLOGY

("HOT SPOTS" ARE AREAS >100 pCi/gU)

ELEVATED SAMPLE LOCATION

LOCATION	DEPTH	pCi/gU
165N - 160E	1.5 - 2.0 METERS	138

METHOD #2: EACH "ELEVATED SAMPLE RESULT IS CALCULATED SEPARATELY.
Shaded area represents elevated location of interest.



NON ELEVATED LOCATIONS

LOCATION	pCi/gU
160N-157E	85
165N-157E	43
160N-160E	66
167N-160E	45
160N-165E	36
165N-165E	46
TOTAL:	321
AVERAGE:	54

ELEVATED LOCATION: 165N - 160E (138) pCi/gU AREA: (16 METERS^2)

$(100/A)^{0.5} = (100/16)^{0.5} = 2.5 \times 100 = 250$ pCi/gU
250 pCi/gU > 117 pCi/gU CRITERIA SATISFIED.

$\bar{X}w = 54[1-16/100] + 138[16/100] = 45.36 + 22.08 = 67.44$ pCi/gU

SUMMARY: NO EXCAVATION REQUIRED. NO VALUES ARE GREATER THAN 3X GUIDELINE. ELEVATED AREA OF 16 METERS^2 WITH CONCENTRATION OF 138 pCi/gU AVERAGE. $(100/A)^{0.5}$ LIMIT OF 250 pCi/gU IS SATISFIED. WEIGHTED AVERAGE OF 100 METERS^2 AREA IS 67.44 pCi/gU.

TABLE 2-4

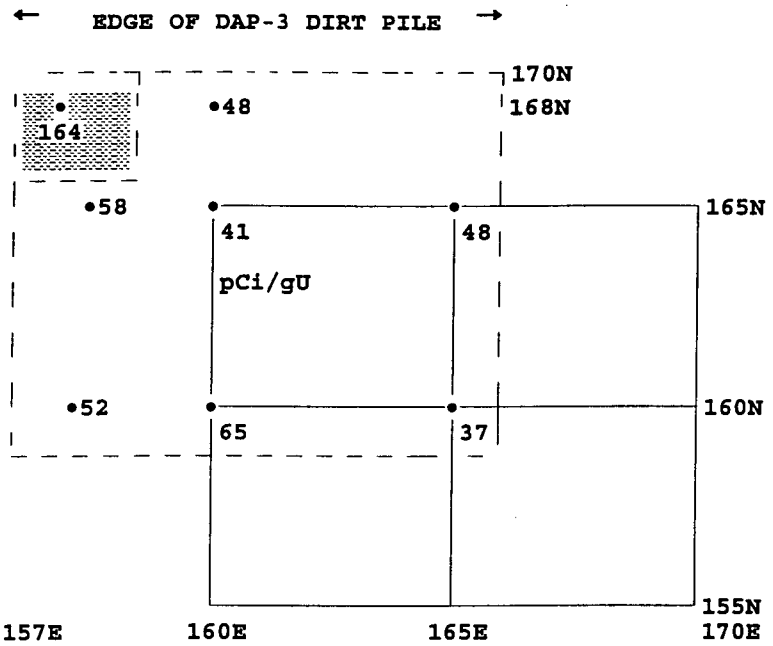
DAP-3 "HOT SPOTS" (ELEVATED LOCATIONS) EVALUATION
NUREG/CR-5849 METHODOLOGY

("HOT SPOTS" ARE AREAS >100 pCi/gU)

ELEVATED SAMPLE LOCATION

LOCATION	DEPTH	pCi/gU
168N - 157E	1.0 - 1.5 METERS	164

Shaded area represents elevated location of interest.



NON ELEVATED LOCATIONS

LOCATION	pCi/gU
165N-157E	58
160N-157E	52
168N-160E	48
165N-160E	41
160N-160E	65
165N-165E	48
160N-165E	37
TOTAL:	349
AVERAGE:	50

ELEVATED LOCATION: 168N - 157E (164) pCi/gU AREA: (6.25 METERS^2)

$(100/A)^{0.5} = (100/6.25)^{0.5} = 4 \times 100 = 400$ pCi/gU (EXCEEDS 3X GUIDELINE.)
400 pCi/gU > 300 pCi/gU > 164 pCi/gU CRITERIA SATISFIED.

$\bar{X}w = 50[1-6.25/100] + 164[6.25/100] = 46.88 + 10.25 = 57.13$ pCi/gU

SUMMARY: NO EXCAVATION REQUIRED. NO VALUES ARE GREATER THAN 3X GUIDELINE. ELEVATED AREA OF 6.25 METERS^2 WITH CONCENTRATION OF 164 pCi/gU AVERAGE. $(100/A)^{0.5}$ LIMIT OF < 300 pCi/gU IS SATISFIED. WEIGHTED AVERAGE OF 100 METERS^2 AREA IS 57.13 pCi/gU.

TABLE 5-1

Comparison of Cimarron Soil Counter Sample Results to Laboratory Analytical Results

Soil samples analyzed using the Cimarron Soil counter were split and submitted for analysis to CORE Lab.

Following is a comparison of analytical results to Cimarron Soil counter results.
Note: The total U for analytical results is the sum of the isotopics:

SAMPLE	LOCATION	CIMARRON COUNTER	CORE LAB ALPHA PULSE HEIGHT							CIMARRON COUNTER	CORE LAB ALPHA PULSE HEIGHT					
		U	TOTAL U	U - 234		U - 235		U - 238		Th	Th-228		Th-232		Pu-239	
		pCi/g	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±
DAC - 1	1	62	66.5	53.1	5.3	2.4	0.5	11.0	1.3	2	1.1	0.3	1.1	0.3	0.1	0.1
DAC - 1	3	36	39.7	31.3	3.4	1.4	0.3	7.0	1.0	2	0.9	0.2	1.2	0.3	0.4	0.4
DAC - 1	6	51	58.5	45.2	4.7	2.2	0.4	11.1	1.4	2	0.9	0.3	0.9	0.3	0.1	0.2
DAC - 1	7	49	42.7	32.4	3.4	1.9	0.4	8.4	1.1	1	0.9	0.3	0.7	0.2	0.1	0.1
DAC - 1	10	47	51.8	41.0	4.2	2.1	0.4	9.7	1.2	1	1.2	0.4	0.9	0.3	ND	0.1
DAP - 3	145	29	24.3	19.8	2.1	1.0	0.1	3.5	0.6	2	1.2	0.4	1.0	0.3	0.1	0.3
DAP - 3	147	60	59.5	48.3	5.0	2.0	0.3	9.2	1.2	1	0.7	0.3	1.0	0.4	0.7	0.6
DAP - 3	150	38	35.3	28.1	3.0	1.7	0.2	5.5	0.8	2	0.9	0.3	1.0	0.3	0.2	0.3
YRD - 01	70N ,105E	10	1.7	0.9	0.3	ND	0.1	0.8	0.3	1	0.7	0.3	0.9	0.3	-	-
YRD - 02	68N,56E	32	29.2	21.4	2.5	1.0	0.3	6.8	1.0	1	0.8	0.3	0.7	0.3	-	-
YRD - 03	69N,117E	24	16	12.6	1.5	0.6	0.2	2.8	0.5	1	1.0	0.4	0.7	0.3	-	-
YRD - 04	69N,56.5E	10	5.2	3.8	0.7	0.2	0.1	1.2	0.3	2	0.6	0.3	1.0	0.4	-	-
YRD - 05	67N,114E	24	28.6	22.0	2.4	0.8	0.2	5.8	0.8	1	1.1	0.4	1.4	0.4	-	-
YRD - 06	WHITE CLAY	34	33.2	24.6	2.8	1.2	0.3	7.4	1.0	5	0.8	0.3	1.0	0.3	-	-
YRD - 07	65N,57E	43	43.6	33.2	3.4	1.3	0.3	9.1	1.1	1	0.9	0.3	0.7	0.3	-	-

SAMPLE	LOCATION	CIMARRON COUNTER	TELEDYNE BROWN LAB ALPHA PULSE HEIGHT							CIMARRON COUNTER	TELEDYNE BROWN LAB** ALPHA PULSE HEIGHT					
		U	TOTAL U	U - 234		U - 235		U - 238		Th	Th-228		Th-232		Pu-239	
		pCi/g	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±
DAP - 3	146	29	17.8	15	1	0.59	0.06	2.2	0.02	2	0.13	0.04	0.18	0.04	<0.02	-
DAP - 3	148	59	39.1	32	2	1.2	0.1	5.9	0.4	1	0.15	0.05	0.15	0.04	0.025	0.019
DAP - 3	152	36	22.1	18	1	0.71	0.08	3.4	0.3	2	0.13	0.04	0.16	0.04	<0.02	-

SAMPLE	LOCATION	CIMARRON COUNTER	TELEDYNE BROWN LAB ALPHA SPEC. X C.F.*					GAMMA SPEC		CIMARRON COUNTER	TELEDYNE BROWN LAB ALPHA SPEC X C.F.*				
		U	TOTAL U	U - 234		U - 238		U - 235		Th	TOT. TH	Th-228		Th-232	
		pCi/g	pCi/g	pCi/g	±	pCi/g	±	pCi/g	±	pCi/g	pCi/g	pCi/g	±	pCi/g	±
DAP - 3	146	29	43 +/- 4	36	17	5.3	0.5	1.4	0.1	2	2.4	0.99	0.3	1.4	0.3
DAP - 3	148	59	90 +/- 9	74	7.0	14.0	1.0	2.8	0.3	1	1.6	0.82	0.27	0.82	0.22
DAP - 3	152	36	40 +/- 4	32	3	6.1	0.6	1.3	0.1	2	2.2	0.99	0.3	1.2	0.3

* The alpha pulse height analyses were normalized using the gamma spectroscopy data. The U-235 and Pb-212 isotopes measured by gamma ray spectroscopy were used to normalize the uranium and throium isotopes, respectively.

**Sample results from Teledyne Brown appear to be suspect due to chemical recovery and the amount of sample preped for analysis.

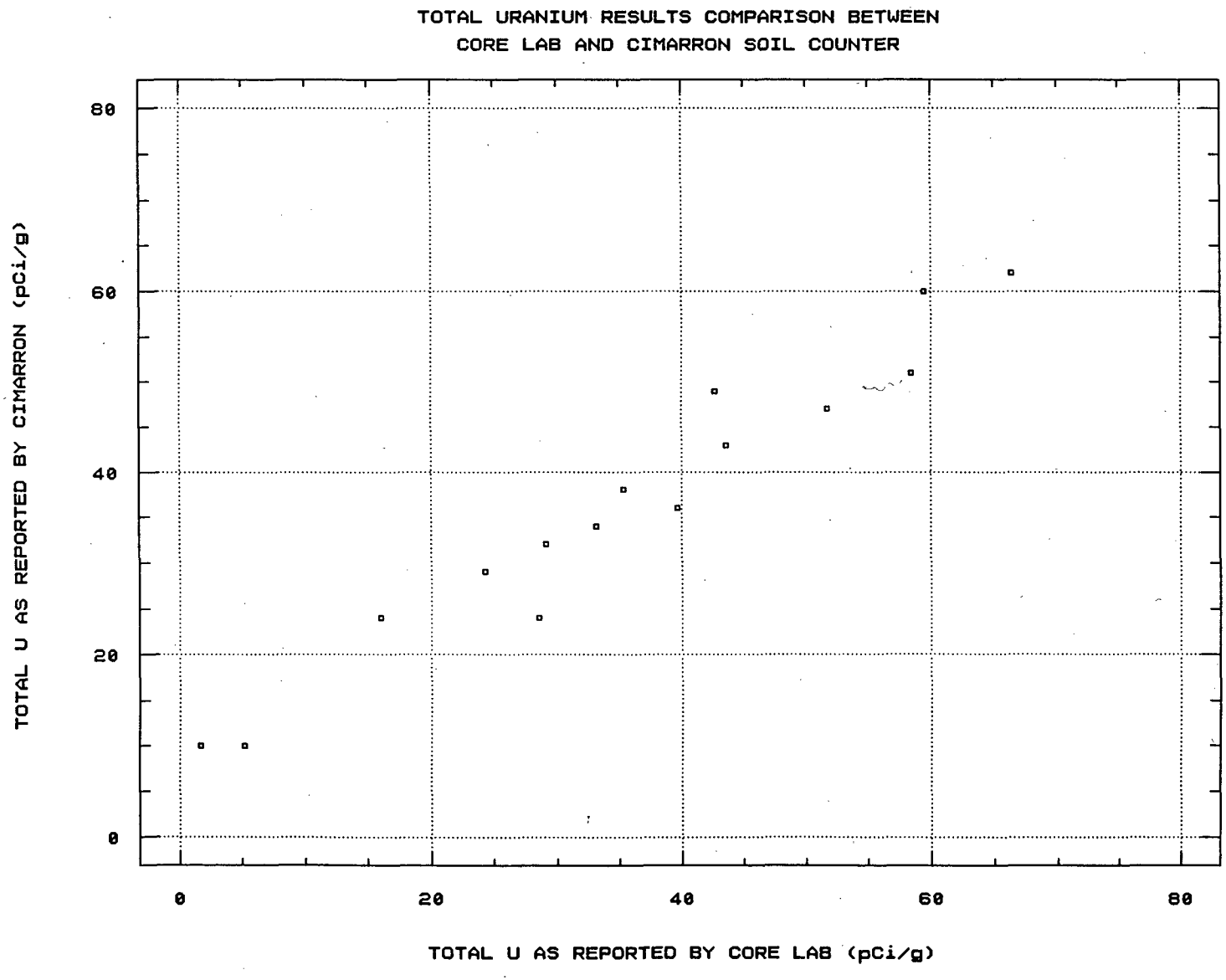
NOTES:
Samples 145 and 146 are splits of the same sample.
Samples 147 and 148 are splits of the same sample.
Samples 150 and 152 are splits of the same sample.

Table 5-2

CIMARRON SOIL COUNTER STANDARDS COMPARISONS

SAMPLE I.D.	CIMARRON COUNTER (pCi/g) RANGE		RESULTS ± 2σ	LABORATORY RESULTS (pCi/g)		
	LOW	HIGH	AVERAGE	LAB-1	LAB-2	ASSIGNED
Bkg. Std.	3.8	9.6	6.3 ± 4	4.53	---	4.5
U-1-2	24.8	31.6	27.7 ± 10	27.4	29.9	28.7
DP-2	113.3	125.7	116.7 ± 21	132.2	137	134.6
DP-1	272.4	291.2	280.0 ± 33	289.6	293	291.6
Th-1	8.5	9.9	9.4 ± 6	10.54	9.04	9.79

FIGURE 2


TOTAL URANIUM RESULTS COMPARISON BETWEEN
CORE LAB AND CIMARRON SOIL COUNTER
TOTAL U AS REPORTED BY CIMARRON (pCi/g)
0
20
40
60
80
0
20
40
60
80
TOTAL U AS REPORTED BY CORE LAB (pCi/g)